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ERATOSTHENES, No. 6
Migration of the Plats.

By WILLIAM H. PICKERING.

We will now take up what is perhaps the most interesting and suggestive phenomenon that we have yet discovered in our exploration of the Eratosthenes oasis. It relates to those plats, or small dark areas, that we can watch actually moving about over the surface of the Moon. While some are stationary, several are known to travel over appreciable distances. Thus Cardinal **9** moves some three miles to the north, and then coalesces with Iris **29**.

COLUMBINE **13**.

This plat we have studied more fully than many of the others, because from its location and visibility we chose it for one of our three primary stations (See Eratosthenes No. 4, Maps A, B, and C, POPULAR ASTRONOMY 1924, **32**, 69). It caused us much inconvenience later, however, because after we had used it for our survey for some time we discovered that it was far from stationary. The other two *c* and *s* are snow areas, and while the former apparently moves a little, its range can hardly equal a mile, although its shape changes materially. Station *s* is a snow craterlet, and so must be stationary. Towards full moon the snow extends beyond its borders, and the crater as such disappears. The snow is then believed to be nearly concentric. The chief difficulty with this station is that it is not very conspicuous at such times, not so much so in fact as it is either earlier or later, or as either of the other stations.

The approximate sizes, shapes, and relative positions of these three stations are shown in Figure 1. Three positions, at colongitudes 20°, 108°, and 180° are given for **13**. For reasons stated in my previous papers, namely,—rapid motion of the Moon in its orbit, difficulty in seeing the objects measured, and the fact that they are not points, but surfaces of appreciable size, and sometimes of irregular shape, it is impossible to secure the same accuracy with them as is attained in the measurement of double stars.

To illustrate this, and show what accuracy may be expected, we have plotted the curves shown in Figures 2 and 3 of the azimuths and lengths of the lines connecting these three points. In both figures the

abscissas represent colongitudes, corresponding to intervals of time. In Figure 2 the ordinates are azimuths or directions measured in degrees from the north, and in Figure 3 English statute miles. Observations by the writer are indicated by circles, those by Mr. Hamilton by crosses. The two observers are seen to agree fairly well with one another. An interval of 12°.2 in colongitude corresponds to one terrestrial day, and colongitudes of 20° and 180° in the case of this crater imply altitudes of the Sun, as seen from it, of about 10° near sunrise and sunset. The heavy vertical line in the figures indicates midday for the crater, and it will be noticed that in three of the curves

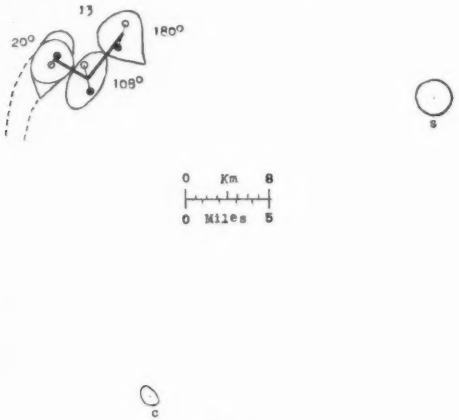


FIG. 1

for **13** a marked inflection is shown shortly after, at 108°. A less marked inflection at about the same colongitude is indicated in the first curve for *c s*. If the three points are stationary with regard to one another, all six lines would be horizontal. That the observations in five cases indicate otherwise is reasonably obvious.

Assuming *s* in Figure 1 to be stationary, the first curve in Figure 2 indicates a motion of *c*, as the lunation progresses, towards the northeast. The relative motion and approach of *c* and *f* as determined from another point *d* has been already referred to in Eratosthenes No. 5. The next curve for azimuth *s* **13** implies a motion of **13** towards the north followed by a more marked motion towards the south. This is confirmed in the last curve for distance *c* **13**, where this distance is seen first to shorten, and later to lengthen. The third curve in azimuth indicates that at first **13** moves but slightly to the east of the line joining it to *c*, but later the motion is more marked. The second curve in distance confirms this, and implies that, owing to its easterly motion, the distance *s* **13** steadily diminishes at a nearly uniform rate. It may be remarked here incidentally, that a motion to the east is exactly the

reverse of what we should expect of a shadow, which on the Moon must move continually towards the west from sunrise to sunset. Since these curves so-called consist in each case of but one or two straight lines, they can be fully represented on a map by two straight lines joining three points. This is shown in Figure 1, where the open circles

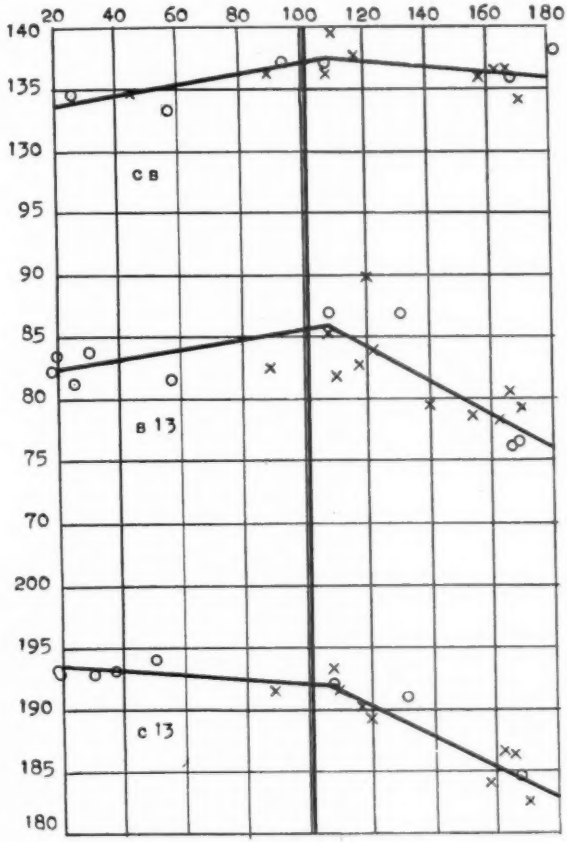


FIG. 2. AZIMUTHS.

represent the result of the survey based on azimuths, and the blackened circles the survey based on distances. These two surveys it will be noticed are entirely independent of one another as far as **13** is concerned, but the azimuth and distance of *c s* are taken in common. That the character and direction of the motion of **13** with regard to the other points is genuine can hardly be doubted.

It will be noticed by the dotted lines that Columbine **13** is situated

on a run extending towards the north-west. The short heavy lines indicate the motion of **13** as shown by our survey. It will be seen at once that this motion prior to 108° lies nearly perpendicular to the direction of the run, and we find by our later drawings that it carries the run with it towards the north-east, the run still, however, retaining

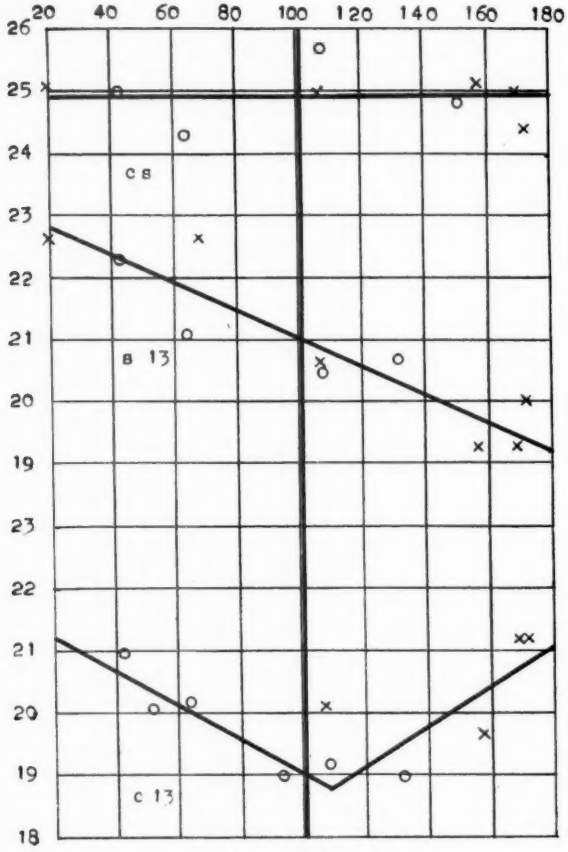


FIG. 3. MILES.

its primary direction. This transverse shifting of the run reminds us of what we have already noted in our Report on Mars No. 26. It was there shown that Ismenius Lacus moved 133 miles southerly, thereby shifting transversely the two canals Protonilus and Deuteronilus through the same distance.

When first clear of the shadows, at colongitude 14°, Columbine appears as a large circular dark spot, somewhat larger than *s*, and ap-

parently occupying a depression in the surface. It soon takes on the pear-shaped form shown in the figure, but by 108° when its northerly motion stops, it becomes distinctly elliptical. The whole of the surrounding region has by this time become very dark, but a run extending towards the south-east soon appears, and a large circular plat develops upon it, not far from the other. The older plat now gradually fades out and disappears, while the new one at the same time darkens and appears to grow at its expense, by the gradual transfer of the dark material along the run between them. This transfer, a little at a time, is therefore quite different from the transfer occurring before the stationary point at 108°, when the whole plat moved as one piece. The distance traversed as a whole to the north-east is two and a half miles in seven days, that traversed to the south-east individually, three and a half miles in six days. The two speeds attained are 1.3 feet per minute, and 2.0 feet respectively.

Rose **51**.

A still more interesting traveller among the plats is Rose **51**, which travels towards the north-west a little over two miles, just before full moon, in a period of rather less than two days, or about 3.7 feet per minute, but apparently completes a much more extensive circuit before and after that time. This plat is also notable because, like Solis Lacus on Mars, it occupies the central position in a bright approximately circular area, nearly surrounded by a dark region, to which it is connected by runs or canals, and thus appears by its very location to be the point of central importance in the whole of this district (See Eratosthenes No. 2 the upper portion of Figure 5, and Eratosthenes No. 3 the upper portion of Figure 1, drawn by Maggini, Popular Astronomy 1921, **29**, 404, and 1922, **30**, 257).

Its changing shapes and positions are shown in Figures 4 to 15, Plates XVII and XVIII of the present article. South is at the top of each figure, and east on the right hand. The squares measure perpendicular to the line of sight just 15 miles on a side. Under each figure following its number is given its date and colongitude. Figure 4 was drawn immediately after the shadow of the western crater wall had left this region. The run Main is seen passing just below the center, extending from the north-east to the south-west, where it terminates in the small rounded plat Tulip **53**, shown better in the next figure. It is dotted with dark areas, which are visible on the Moon only with difficulty. Two are also found in Tulip. Above it and to the east lies a much narrower run called Curve, which is bent in the opposite direction. This appears to start out as a crack, but soon develops into a narrow run. It terminates in the south in the little plat Thistle **52**, which eventually turns out to be of much more importance than its size might lead us to expect. Directly east of Thistle lies the large spindle-shaped plat Rose **51**, with which we shall be chiefly concerned.

It is prolonged to the north-east by the wide run Broad. Following down the rim of the crater more than half way to the bottom of the square we come to a little insignificant, but important plat, Poppy **49**, which soon disappears, but towards the end of the lunation again becomes visible. Extending towards the south from it lies the broad Wing Run. Just before reaching the bottom of the square it crosses a bright rill with three small plats upon its southern edge, one of which is shown in the drawing. This one is Phlox **45**. It is only visible early in the lunation, but has been of material assistance in our survey.

North-west of Main lie four plats joined by a narrow run. The northernmost of these, Laurel **36**, and the run which later extends south-eastward from it were discussed in our last paper on Eratosthenes, No. 5. The second plat, Lily **35**, appears to be double, but this appearance soon wears off. Both of these plats vary greatly in size as the lunation progresses, and both for a time disappear. The next two plats, Lilac **33** and Lotus **31**, are of no particular importance. South of the latter lies Jasmine **30**. This appears as a dark narrow elongated cleft, but as full moon approaches it becomes more rounded, and later fades out. Finally nearly due south of Thistle lies Bluebell **5**, which grows in size and faintness as full moon is approached, and then later disappears for good.

Returning to Poppy we find two runs extending southerly and south-westerly from it and joining it to Broad. Between these runs and to the north-east of them the outer slope of the crater is comparatively light, but in Figure 5 this region has darkened so far that the two runs are no longer visible. Possible traces of them can be seen in Figure 6, but this region is now darkening with the rising Sun, and developing into the great South-Eastern Field, so that these runs will not again be visible until after colongitude 110°. As we travel south from Poppy in Figure 4 the darkness increases, and in Figures 5 and 6 is seen to have distinctly concentrated in the southern part of Rose. In these two figures we notice that both Laurel and Tulip have increased in size while Lily has somewhat diminished. It disappears in Figure 9, although three of its connecting runs are still visible. In Figures 5 and and 6 Tulip and Rose have sent out runs connecting them with Thistle, as have also Jasmine and Bluebell. We notice also how Main swings southerly, as mentioned in former papers, until in Figure 6 it is tangent to Curve. The northern part of Main, where its darkness suddenly falls off, is thus also connected directly with Thistle through Curve. Nevertheless Thistle itself has hitherto not increased in size. The method of joining Rose to Thistle is for the former to send out a point like a thorn. On reaching Thistle this widens into an ordinary run.

Turning to Figure 8, we note how Rose has now begun to pour its contents into Thistle, which has enlarged appreciably, while Jasmine does the same from the other side. Figure 7 was drawn 2° of co-

longitude, equivalent to 4 hours of time, earlier than Figure 8, but we see that in it a complete union of Rose and Thistle has already taken place. This illustrates very nicely the differences that sometimes occur in different lunations, as has indeed been already shown in our paper Eratosthenes No. 5. Compare also Figures 11 and 12. The connection of Bluebell with Thistle is more marked in Figure 7 than in Figure 8, and another plat to the east of it, called Aster, is also pouring its contents into Thistle through Rose (See also Figures 9 and 12). Having now apparently accomplished its object in permitting the dark material to be transported from Poppy to Thistle, by way of Rose, Broad becomes narrower and curves more directly towards Thistle, in Figures 9 and 10. Later the curvature, narrowing and faintness become still more marked. Tulip, which as we have already seen grew steadily in size in Figures 4, 5, and 6, after that slightly declined, and changes its shape between Figures 8 and 9. It takes a new form in Figure 10, and is last seen in Figure 11. The changes in width of Laurel Run, described in Eratosthenes No. 5, are clearly shown in Figures 6 to 10.

Whatever the action of the other runs may be, Main now becomes most concerned in the result and in Figures 9 to 14 pours directly into Thistle. The continued although somewhat irregular change in the shape of Rose throughout these twelve figures, is very marked, and the sudden drop in size between Figures 12 and 13 is striking. It is not believed, however, that this usually occurs, because, comparing Figures 11 and 12, the former appears to be distinctly precocious, and to bear a closer resemblance to Figure 13, and even to 15, than does 12 to 13. Through Figure 10, and also in Figure 12 Main appears as a broad single stream, but after that it divides in two parts, of which one, (the eastern one) later gradually fades out. It perhaps carries the laggards down to Thistle, while the other carries the regular body of migrants north through Violet **54**, and Wisteria **55**, back to Poppy, whence the stream began.

In what precedes I have implied a definite direction to the current. This does not of course necessarily follow from the observed facts, but an examination of the successive shapes assumed by Rose and Thistle appears to bear it out. What we can say nevertheless is that we know from the drawings and measurements of Columbine **13**, and also of other plats, that these bodies do travel over the surface of the Moon, and accepting that statement as a fact, the most probable course of the dark material found in Rose, it seems to me, is the one above described. In the final figure a dark stream from a plat located a little to the north of Thistle, which plat, suspected in Figure 13, has now reappeared, joins the one from Thistle at Violet, returning with it to Poppy along the run already shown in Figure 4. Both Violet and Wisteria lie within the crater rim, and accord well in position with two of the dark spots shown in Main, in Figure 4. They can be

identified by comparing their positions with those of Poppy, Laurel, and Lily. Subsequent events in this little area of the Moon's disk need not detain us. No appreciable change after Figure 15 occurs until after colongitude 158° is reached. By 167° Laurel has become absorbed in the sunset shadows, which also darken some of the runs. By 182° all of this region lying within the crater is enveloped in the lunar light.

It is quite probable that some will criticize us if we go any further, and attempt to explain these observations, since we know so little of the lunar surface conditions,—and what we do know indicates that they differ so markedly from what we find upon the surface of the earth. They will say collect and give us simply facts. Yet I am inclined to believe that the majority of intelligent opinion will so far agree with me as to believe that some explanation is better than none at all. If future observations prove it to be wrong, and enable us to find a better one, then it will at least have served to advance the cause of knowledge by showing what is not so. For this very purpose the use of what has been called the "scientific imagination" is believed by many persons to be not only not reprehensible, but in many cases distinctly desirable.

In our previous papers we have been careful to point out that the assumed absence of oxygen in the lunar atmosphere is by no means a conclusive argument against the existence of either vegetable or animal life. It is now well known that certain intestinal worms with well developed digestive and nervous systems secure their only supply of oxygen from their food, which they obtain from their hosts, and prepare themselves. It requires no grave assumption to conceive that lunar life may thus similarly exist on food which it secures in the absence more or less complete of free atmospheric oxygen.

Another objection which is sometimes advanced by critics with regard to the possibility of life upon the Moon is the high temperature which is believed to exist upon that body. Let us see what facts we have at present at our disposal bearing on this matter. In the hot springs of the Yellowstone National Park certain algae or pond weeds flourish and propagate in water whose temperature exceeds 90° C. or 194° F. In the early geological ages when our Sun was much hotter than it is today, in case this temperature was then reached in the earth's atmosphere, there is little doubt but that land forms of vegetation, and possibly also of animal life were able to adapt themselves to it.

The maximum temperature recorded by the Weather Bureau in Death Valley, California, was 134° in the shade. A series of measurements made in Arequipa Peru, altitude 8000 feet, of a thermometer lightly buried in the sand, and exposed to the Sun, as compared with one exposed in a standard instrument shelter, showed on 12 days out of 19 an excess of temperature of over 20°. On one day the difference was 25°. The observations were made in the latter half of September and October, when the Sun passed well to the north of the zenith.

PLATE XVII.

FIGURE 4
May 12, '24. 19°1

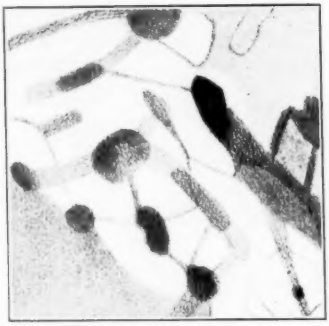


FIGURE 5
May 14, '24. 44°3

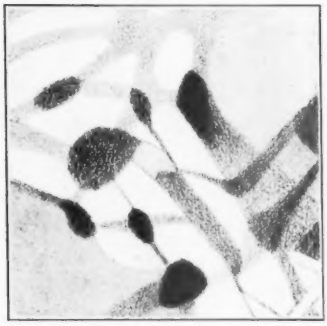


FIGURE 6
May 15, '24. 57°4

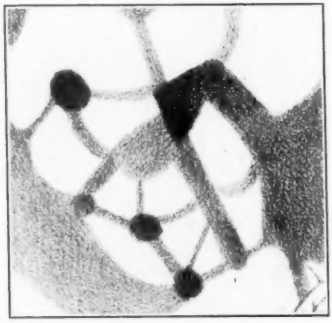


FIGURE 7
Nov. 21, '23. 74°2

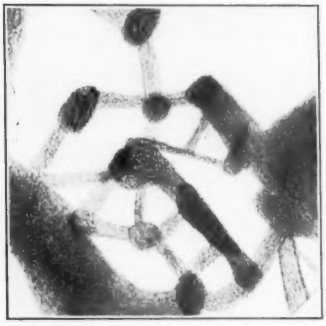


FIGURE 8
Apr. 17, '23. 76°1

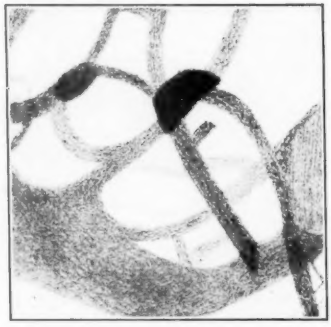


FIGURE 9
Feb. 19, '24. 88°2

DRAWINGS OF THE S. E. PORTION OF THE RIM OF ERATOSTHENES.

POPULAR ASTRONOMY, No. 317.

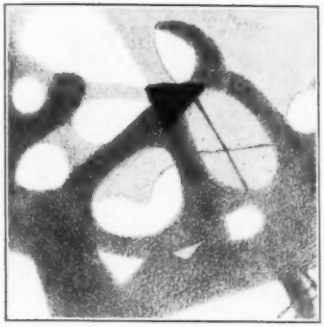


FIGURE 10
Apr. 20, '24. 113°6

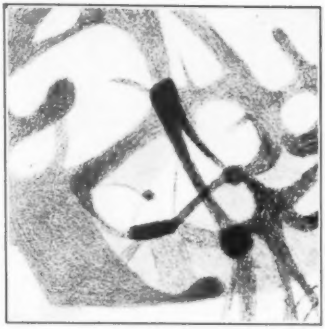


FIGURE 11
May 20, '24. 120°7

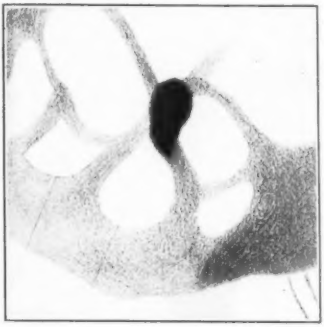


FIGURE 12
Jan. 23, '24. 120°9

FIGURE 13
July 30, '23. 125°0

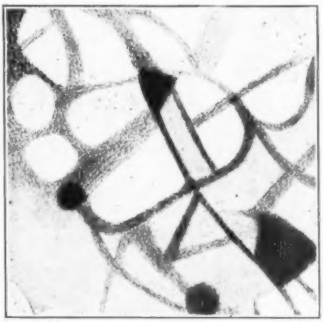


FIGURE 14
Feb. 22, '24. 127°9

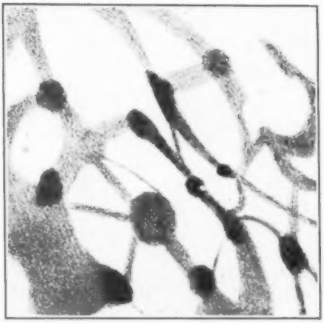


FIGURE 15
Apr. 22, '24. 137°8

DRAWINGS OF THE S. E. PORTION OF THE RIM OF ERATOSTHENES.

Similar results have been obtained here in Jamaica. There is therefore little doubt but that a thermometer similarly exposed in the sand of Death Valley would occasionally reach a temperature of 160° F. or 71° C. Since our atmosphere cuts off but little of the heat-bearing rays, we conclude, until we obtain further evidence in the matter, that 70° C. is a fair estimate of the temperature of a large portion of the Moon's surface where it is exposed perpendicularly to the Sun's rays, but that a thermometer if placed there in a standard shelter might very likely register an air temperature as much as 25° F. lower. Furthermore that this temperature could be withstood for a time even by man.

Returning now to our observations, in our fourth paper the preliminary data and maps were given, and in our fifth our reasons for explaining some of the observations secured, notably those pertaining to the darkening and spread of Laurel Run, as due to vegetation rather than to animal life. We also stated that this vegetation was not supposed to resemble closely anything that we call vegetation upon the earth, which certainly could not live upon the Moon, but that it did resemble our vegetation more than it did our minerals, and more than it did our animal life. It would surely be ridiculous to invent a new name for it. We have therefore adopted the Martian analogy, and called it simply vegetation.

In our present paper we have described and illustrated another phenomenon, to which we have indeed casually referred in our former articles. This is the observed actual traveling of dark objects across the surface of the Moon. Vegetation as we know it grows and spreads but does not travel from place to place. If an observer could have been placed upon our Moon one hundred years ago, on examining our western plains with his glass, he would have been able to detect certain large dark objects measuring several miles in either direction, moving over the surface at a speed of let us say three miles an hour, or 260 feet per minute. We know that these dark objects which he detected would have been herds of grazing and traveling buffalo. The moving dark objects which we see upon the Moon are of about the size of the original buffalo herds, and if they moved at that speed, we might reasonably conclude that they were attributable to animal life. In point of fact they move at a much lower speed,—only a few feet per minute. Such being the case we may conclude that the individuals which compose them, if such they are, are much smaller than the buffalo, and also much more numerous.

Starting then with the hypothesis that these moving dark objects on the Moon are really swarms of animal life, we will submit it to a few simple numerical computations in order to show what is possible and what is not. Little attention has apparently been paid by naturalists to the speed of travel of our smaller terrestrial animals. In the *Proc. Nat. Acad. Sci.* for 1920, **6**, 204, Professor Shapley contributes a brief study of the motions of a certain species of California ants

at varying temperatures. The species studied was the *Liometopum Apiculatum* Mayr, and he found that with increasing temperature they traveled faster and faster. The highest temperature observed was 100° F. At this temperature they traveled at a speed of a little over 6 centimeters per second, or 12 feet per minute. Unfortunately he does not give the size of the ants, but I have found the same speed here for tropical red ants ranging from 7 to 8 millimeters, or about one-third of an inch in length. They were running along a covered electric light wire just before sunset, at a temperature of 70° F. They were moving at about twice the speed of the dark swarms upon the Moon, but we must remember that the ants are the greyhounds of our insect world. Moreover the lunar swarms travel continuously for twelve terrestrial days, while the speed of the ants was measured for only a few minutes until they reached their home. Judging by these considerations we might believe that the lunar "insects," if we may so call them, were fully equal in size to the ants.

But there is another method of estimating the size of the individuals of the lunar swarm. Still dealing with the ants, let us now assume that 20 of these animals can travel upon one square inch of surface, and that their color when traveling over a light colored background will be sufficient to impress the observer as dark gray or black. There would on the above supposition be 80,000 million to a square mile, or about as many as there are bacteria in a pint of soup culture. Shapley's ants weighed 140,000 to the pound. A square mile of them, at 20 to the square inch, would weigh 285 tons. A half ton cow can be supported continuously on three acres of grass land. Hence 285 tons of lunar ants could under similar conditions be supported on 1700 acres, or a trifle less than three square miles, that is on three times their area. The dark regions immediately surrounding Rose Plat greatly exceed it in area, and supposing lunar and terrestrial conditions sufficiently similar, could thus readily support such a swarm.

In order to form an estimate of the probable maximum size of the lunar insect life, let us now compare it with another of our terrestrial animals of much larger size, the locust, *Acridium Peregrinum,* which sometimes creates such devastation in eastern Asia and Africa. According to the Encyclopaedia Britannica, their bodies are about two inches in length. The number of insects of this size on the Moon per square mile, based on the above computations, would then be reduced to 2000 million, but they would require six times as large an area of vegetation to support them. This according to our drawings is about as large an area as appears to be available, and implies that the insects cannot be much larger than this. An interesting description of the locusts appeared in the *National Geographic Magazine* for December 1915. When they appear in flying swarms they will sometimes completely obscure the Sun, and the roar of their flapping wings is deafening. In South Africa swarms have been estimated to measure

fifty miles in length by five in width. When they alight they darken the ground. Their eggs are laid about a hundred in a hole, and at a frequency in favorable places of 6000 per square foot of surface. This would correspond to 150,000 million per square mile, or about twice the frequency that we found for the lunar ants. By means of a suitable trap, managed by a few men, half a million can be destroyed per hour.

There is of course no reason to suppose that the lunar insects resemble locusts either in appearance or habits, any more than they do ants. There is indeed no reason to suppose that they resemble any terrestrial animals. Since their environment is so different, we may say further that it is extremely improbable that they do resemble any terrestrial form of life, but since it is not worth while to coin a new name for them, and since they must be as we have seen of the same order of size as our insects, we will simply call them by that name, whether they have two legs, four, six, or fifty.

In trying to find conclusive arguments for or against the existence of animal life upon the Moon, I have necessarily studied not only the routes along which it appears to travel, but also the reasons for which it might be expected to travel. Numerous terrestrial animals migrate at times, such as seals, lemmings, birds, salmon, eels, and locusts. Their reasons appear to be only of two kinds, either in search of food like the lemmings, birds, and locusts, or in order like the seals and fish to propagate their kind. We do not know how the lunar swarms are fed, whether they simply follow their leaders, or whether they are driven and fed by larger and perhaps superior animals. It is easy to devise different explanations of observations when only the most fundamental facts are known. It may be of interest however in closing, to state what after some consideration seems to me to be the most probable cause of migration. It appears likely in the first place that the life of the individual migrants may be brief, only a half lunation or fourteen terrestrial days. It also appears that in at least one respect the life in Columbine differs from that in Rose. In the former, as with the locusts, the darkening swarm does not appear to return to its place of origin. In the latter, as with the seals and birds, there is as we have seen, evidence of such a return. Indeed, as in the case of the seals, there appear to be two swarms, one proceeding along Broad, and the other along Main. When they reach the vicinity of Thistle both deflect towards one another as if by mutual attraction. Compare the curvature of the two runs Main and Broad, in Figures 4 and 9. Between Figures 7 and 12, colongitudes 74° and 121°, the combined bulk is larger than later, and since there is no evidence of any further travel through Broad, it seems plausible that the dark line leading back to Poppy by way of Violet drains off the surplus, and is the returning stream of migration towards the north. This must be the life bearing stream, transporting the embryos for the next lunation, and deposit-

ing those which shall again traverse Main along its course in Violet and Wisteria, while those which are to traverse Broad to Rose must be carried on further, and deposited in Poppy, thus completing the circuit of the journey for them.

While this suggestion of a round of lunar life may seem a little fanciful, and the evidence on which it is founded frail, yet it is based strictly on the analogy of the migration of the fur bearing seals of the Pribiloff Islands, of which the male herd is distinct and separate from the female. It arrives at the breeding grounds in May, and the females a few weeks later. The distance from Poppy to Thistle and back again is about twenty miles, and is completed in twelve days. This involves an average speed of six feet per minute, which as we have seen implies small animals. If food reaches Thistle from the extensive and concentric dark fields surrounding it, and which reach their maximum extent and darkness just before Thistle is occupied, there would then seem to be sufficient food for a swarm of animals not exceeding the size of locusts.

It must now be the aim of any of our successors, who may be interested in such matters, to seek evidence to prove or disprove the adequacy of this explanation of the moving plats, and if found incorrect, then in the light of such evidence to formulate an explanation more in accordance with the facts. This paper will perhaps be our last on lunar matters, since Harvard has decided to dismantle the Mandeville station, and remove the telescope to Cambridge, where lunar work is impossible. Unless funds are forthcoming from other sources to replace it, this station will then be closed, and the lunar work will come to an end.

DEDICATION OF THE 20-INCH EQUATORIAL TELESCOPE OF THE CHABOT OBSERVATORY TO CHARLES BURCKHALTER, MAY 18, 1924.

Professor Earle G. Linsley, director of the Chabot Observatory, Oakland, California, has sent to POPULAR ASTRONOMY the following notice of the dedication, on May 18, 1924, of the 20-inch telescope of the Chabot Observatory to Charles Burckhalter, the former director of that observatory.

On Sunday afternoon, May 18, 1924, before an appreciative audience gathered in the large dome of the Chabot Observatory, Oakland, California, the twenty-inch refractor, which cost in 1915 about 20,000 dollars, was dedicated as a memorial to Charles Burckhalter, who was director of the Chabot Observatory from very near its beginning.

This dedication was accomplished by the unveiling of a plaque, authorized by the Board of Education of the city of Oakland, as an expression of appreciation of the long, faithful, and distinguished service in the unique position which the city astronomer of Oakland holds. For no other city in the world possesses as part of its Public School system an observatory with the equipment equal to that in the Chabot Observatory of Oakland. The present building, though incomplete,

and the great telescope are largely the result of the tireless efforts of Charles Burckhalter through many years.

The plaque placed upon the pier of the 20-inch telescope contains a medallion of Mr. Burckhalter and these words: "This telescope is dedicated to the memory of and named for Charles Burckhalter, Director of Chabot Observatory 1885-1923, by the Oakland Board of Education. He devoted his life to the youth of Oakland that they might know Eternal Truth as it is written in the Stars. 'The Heavens declare the Glory of God the Firmament showeth His Handiwork'."

At the unveiling of the plaque Mr. J. F. Chandler of the Board of Education presided; Mr. Fred M. Hunter, Superintendent of the Oakland Public Schools spoke upon "Mr. Burckhalter as a Teacher"; Prof. Earle G. Linsley, of the Department of Astronomy Mills College and Director of the Chabot Observatory, spoke upon "Mr. Burckhalter and the Observatory"; and Dr. Robert G. Aitken, acting Director of the Lick Observatory spoke upon "The Life Work of an Astronomer."

COMPLETION OF THE HENRY DRAPER CATALOGUE.

By HARLOW SHAPLEY.

The concluding pages of the last of the nine volumes of the Harvard Annals containing the Henry Draper Catalogue were printed on June 14, 1924. The first pages of the first volume were printed in August, 1917. The classification of the stars by Miss Cannon was begun October 2, 1911, and completed September, 1915; but subsequently, in the course of preparing the volumes for printing, several hundreds of stars have been added or reclassified.

The catalogue contains the positions, magnitudes, and spectra of 225,300 objects, divided among the volumes as follows:

Vol.	Harvard Annals	Published	Number of of Stars	Right Ascension Limits h h
1	**91**	1918	25,763	0 — 3
2	**92**	1918	27,681	4 — 6
3	**93**	1919	24,428	7 — 8
4	**94**	1919	27,081	9 —11
5	**95**	1920	28,587	12 —14
6	**96**	1921	20,834	15 —16
7	**97**	1922	23,151	17 —18
8	**98**	1923	23,181	19 —20
9	**99**	1924	24,594	21 —23

The work was planned by Professor E. C. Pickering, with the assistance and advice of members of the Harvard Observatory staff and other astronomers. The editorial work has been in the hands of Professor Pickering, Professor S. I. Bailey, Miss Cannon, and the writer. The assistants who have contributed most to the recording, checking, determination of positions, reduction of magnitudes, and proof reading are Misses G. R. Brooks, A. M. Carpenter, F. Cushman, E. F. Gill, M. A. Hawes, H. S. Locke, J. C. Mackie, L. D. Wells, and M. A. White.

Approximately fifteen thousand photographic plates were used for this work, chiefly made (for faint stars) with the 8-inch Bache and Draper telescopes using various objective prisms. For the brighter stars larger telescopes with greater dispersions were employed. The photographs at Cambridge were made under the supervision of Pro-

fessor W. P. Gerrish and Professor E. S. King, and the work at Arequipa, for the southern sky, was at different times in charge of Professor W. H. Pickering, Professor S. I. Bailey, Mr. R. H. Frost, Dr. DeLisle Stewart, and Mr. Leon Campbell. The total cost of the catalogue, distributed unevenly throughout the years since the accumulation of the necessary spectrum plates was begun, may be uncertainly estimated at a quarter of a million dollars—largely paid from funds provided by Mrs. Henry Draper. Special gifts to aid in the observations and in the printing of the catalogue have been made by Mr. G. R. Agassiz, Professor E. C. Pickering, Mr. and Mrs. C. W. Elmer, and Mrs. James R. Jewett. An edition of six hundred copies has been issued. The printing was done by the Harvard University Press.

Discussions of the assembled data have been published during the past two or three years in Harvard Circulars 226, 229, 239, 240, 243, 245, and 248; Harvard Bulletins 787, 792, 796; Proceedings of the American Academy of Arts and Sciences **59**, No. 9, 1924; Scientific Monthly **18**, 449, 1924; and elsewhere. Lists of errata are given immediately after the preface in Harvard Annals **98** and **99**. A description of the Harvard classification of spectra is given in each volume. A note on the accuracy of the published positions appears in Harvard Annals **98**, 14, and a special note on the magnitudes in **96**, 14.

To supplement the Henry Draper Catalogue, particularly for the faint stars in the Milky Way, an extension of the work is now in progress. Special plates for magnitudes and spectra have been procured in several regions. The extension will be printed in small parts as soon as completed. The first installment may appear within a year.

THE NEW CALENDAR OF THE EASTERN CHURCHES.

By MIRIAM NANCY SHIELDS.

In number 5279 of the *Astronomische Nachrichten*, issued on March 18, 1924, is an article by M. Milankovitch of Belgrade, dated October, 1923. Its title is "The End of the Julian Calendar and the New Calendar of the Eastern Churches." M. Milankovitch, as indicated below, was a delegate to the congress which decided upon this new calendar; it is a slight improvement over the Gregorian calendar.

Thinking that this matter is of general interest I have translated this article, endeavoring to give a faithful reproduction of the author's statements.

In May, 1923, there met in Constantinople under the presidency of the ecumenical patriarch, Meletius IV, a congress of the orthodox oriental churches (of which the Russian, the Greek, the Serbian and the Roumanian are most important) which decided on a reform of the

Julian calendar or rather the replacement of it by a new calendar. This decision has already been carried out by the Russian church; the others may soon follow, so that the Julian calendar, now almost 2000 years old, will go out of use.

I had the honor to take part in this congress as delegate of the government of the Serbs, Croatians and Slovenes and as a representative of astronomical science. Therefore I may be permitted to report on the important decisions of this congress in regard to the question of the calendar, and to explain them briefly.

As is known, heretofore all the oriental Christian churches held fast to the Julian calendar, which is thirteen days behind the Gregorian. This condition proved to be inconvenient, particularly in the newly organized South-Slav and Roumanian kingdoms, with their mixed Greek-Orthodox and Roman Catholic populations, whereby the otherwise numerous holidays were celebrated twice. A reform of the Julian calendar was, therefore, an urgent necessity, especially since its inadequateness had been shown by science long ago. A complete adoption of the Gregorian calendar was, however, not advisable either from a religious or scientific standpoint because the astronomical data concerning the length of the tropical year which lay at the base of the Gregorian reform are now replaced by others. So it was advised to remove the difference of thirteen days mentioned before, but by the distribution of leap years to make allowance for the progress of astronomy. But in order not to go too far and make a new divergence between the dates of the two Christian calendars in future time, a leap-year rule proposed by me was accepted, which differs from the Gregorian but nevertheless agrees with it until the year 2800.

The principle of this leap-year rule is very simple. In the Julian calendar every fourth year was a leap-year, which gave an average length to the calendar year of 365 days 6 hours, which is more than 11 minutes greater than the length of the tropical year. On this account the Gregorian calendar counts as leap-years only those century years whose first two figures are exactly divisible by four. Of the following century years only the years 2000, 2400, 2800, etc., will be leap-years. In this way during the space of 800 years six days are left out—contrary to the Julian calendar—and thus an average length of the calendar-year is obtained which differs by twenty-six seconds from the length of the tropical year. The new leap-year rule of the orthodox churches, on the contrary, is laid down as follows. Of the century-years only those shall remain leap-years whose first two figures when divided by nine give a remainder of two or six. Hence of the following century-years only the years 2000, 2400, 2900, etc., will be leap-years. First, one can see from this that a deviation from the Gregorian calendar will first occur after 877 years; second, that by this leap-year rule during the space of 900 years seven days are removed from the Julian calendar. This gives an average length for the calen-

dar year of 365 days, 5 hours, 48 minutes and 48 seconds, which differs by only 2 seconds from the present length of the tropical year.

The establishment of the date of Easter brought some difficulty to the Congress. As is well known, the date of Easter depends on the phases of the moon, since Easter must fall on that Sunday which follows the first full moon after the vernal equinox. This rule, which has been accepted by all Christian churches, is so clear and unequivocal that (it would seem) no difference would be possible in regard to the date of Easter if one determined the phases of the moon accurately and not by the old rules of reckoning which give inaccurate results. For this reason the Congress of Constantinople decided—on the proposal of its president—that the phases of the moon necessary for the establishment of Easter shall be ascertained by accurate astronomical computations in which the date of the Jerusalem meridian governs.

On account of this arrangement the Easter-dates of the two Christian calendars will disagree six times during the next fifty years, in 1924, 1927, 1943, 1954, 1962 and 1967. The dates of Easter in the eastern churches for these years are as follows: March 23, 1924, April 24, 1927, March 28, 1943, April 25, 1954, March 25, 1962, and April 2, 1967, while in the Gregorian calendar the dates are as follows: April 20, 1924, April 17, 1927, April 25, 1943, April 18, 1954, April 22, 1962, and March 26, 1967. The reason for this divergence is the following: in the years 1924, 1943 and 1962 the true full moon comes several hours after the vernal equinox, while the Gregorian epact-reckoning places it before the equinox. In the years 1927, 1954 and 1967, the true full moon falls on a Sunday while the epact-reckoning places it on Saturday.

Moreover it is to be hoped that these differences will soon be adjusted, since the Congress of Constantinople has decided to take steps to bring about a complete agreement of the Christian calendars, which may very easily be brought to pass by good will on both sides.

After these introductory remarks the following statement of the decisions of the Congress of Constantinople on the question of the calendar will be entirely intelligible.

1. Thirteen days are taken from the Julian calendar, which represent its difference in time caused by counting in solar years since the first ecumenical council in Nicaea. Accordingly October 1, 1923 will be counted as October 14, 1923.

2. The holidays which fall on the days taken away will either all be celebrated together on October 14, 1923, or when the bishop of the diocese orders.

3. All the months of the year will keep the same number of days in the future as they have had in the past. As before, the month of February will have 29 days in leap-years.

4. As previously, there will be two kinds of years, common years

with 365 days, and leap years with 366 days. Those years will be leap-years which can be divided without remainder by 4, as has been the case heretofore. Only the century-years form an exception for which the rule of the following paragraph applies.

5. The century-years (those which end with two zeros) will be leap-years only if their century-numbers when divided by 9 give a remainder of 2 or 6. All the other century-years will be common years. Accordingly, of the following century-years only those printed in heavy type will be leap-years.

2000 2100 2200 2300 **2400** 2500 2600 2700 2800
2900 3000 3100 3200 **3300** 3400 3500 3600 3700

By this arrangement the average length of the civil year is 365 days, 5 hours, 48 minutes and 48 seconds, in close agreement with the length of the solar year.

6. The fixed holidays retain the dates which they have had up to this time.

7. The movable holidays depend on the date of Easter. In agreement with the canonical decisions which remain unchanged Easter will be celebrated on the Sunday which follows the first full moon after the vernal equinox.

8. The Easter full moon will be determined by astronomical calculations; allowance is thus made for expected improvement in our knowledge. The date of Easter will always be determined by the time of the Holy City, Jerusalem.

9. The ecumenical patriarch will request the observatories or chairs of celestial mechanics in Athens, Belgrade, Bucharest and Pulkowa (Petrograd) to compute long-time Easter tables, and will give them to all the orthodox churches.

10. This reform of the Julian calendar can in no way be a hindrance to a later alteration which might be made by all Christian churches.

Addendum to 5.

The new calendar is more accurate than the Gregorian, the average length of whose year differs by 24 or 25 seconds from the length of the tropical year. The difference between the length of the average civil year of the new calendar and the Gregorian is so small that a difference of date will first occur after 877 years. Of the following years the heavy typed ones are the leap-years of the Gregorian calendar.

2000 2100 2200 2300 **2400** 2500 2600 2700 **2800**

A divergence first takes place in the year 2800.

Addendum to 8.

Because the day is reckoned from midnight to midnight the civil

date of the first opposition of the moon after the vernal equinox will be determined by reckoning the time according to the meridian of the Church of the Holy Sepulchre. The first Sunday after this date is Easter. If this date itself falls on Sunday, Easter will be celebrated the following Sunday.

University of Denver, May, 1924.

THE SHADOW BANDS OF TOTAL ECLIPSES.

By CHARLES S. HASTINGS.

The shadow bands frequently seen for a few seconds immediately before the second and after the third contact in total eclipses of the sun are an impressive feature which adds immensely to the awe inspiring spectacle. This is due not only to the eager attention of the observer, the rarity of the phenomenon which occurs only at such moments, but also to the lack of an obvious cause. Still, the explanation does not seem difficult although apparently overlooked.

A short description of the phenomenon will prove helpful to the reader who has not had the good fortune to observe a total eclipse of the sun.

During the brief intervals mentioned the ground, and every other surface exposed to the sun, appears to be covered with bands of alternate light and shade which generally move with considerable speed, sometimes in one direction at right angles to themselves, sometimes in the opposite. The separation of the bands varies greatly; in exceptional cases, as in that which I observed in the eclipse of 1900 at Norfolk, Va., on the roof of the hotel, they were very close together and seemed to oscillate slowly instead of sweeping by at a considerable speed. At that occurrence the air was very quiescent.

The explanation which I offer is as follows:

Suppose one could take an instantaneous photograph of a plane surface illuminated solely by a single star; it is evident that, owing to the imperfect homogeniety of the air, the photograph would show a mottled distribution of light and shade. Moreover, it is obvious that the irregularities of distribution would be due to the lower levels of the air, just as the reticulated illumination of a wall from sunlight reflected from a rippled surface of water occurs only when the distance from reflecting surface to screen is inconsiderable. A similar illustration might be borrowed from the character of the illumination of a wall by an arc light shining through a window of ordinary glass—the irregular mottling vanishes when the wall is remote from the window.

Now suppose that the source of light, instead of being a point-source as in case of the star, becomes a linear source of even moderate

angular length, then the features of the mottled surface which are perpendicular to the source would become obscured while those at right angles to them would retain their distinctness, hence the shadows would have a banded appearance with the bands all lying in planes containing the source irrespective of the inclination of the surface upon which they are seen and therefore parallel to each other. If the air is in motion the bands would move with it but only the component of the motion perpendicular to themselves would be recognized by the observer; hence they would always appear to move in a direction at right angles to their direction. This condition of the source obtains a few seconds before and after the total phase of the eclipse.

NOTE:—This explanation was published by the present writer in a book, "Light," one of the Yale University Bicentennial Series; but it is certain that few astronomers have seen it and it may serve a useful purpose to call attention to it.

Yale University, April 24, 1924.

OBSERVATION OF THE HEAVENS.

By FREDERIC R. HONEY.

(Continued from page 349.)

OBSERVATIONS OF THE PLANETS.

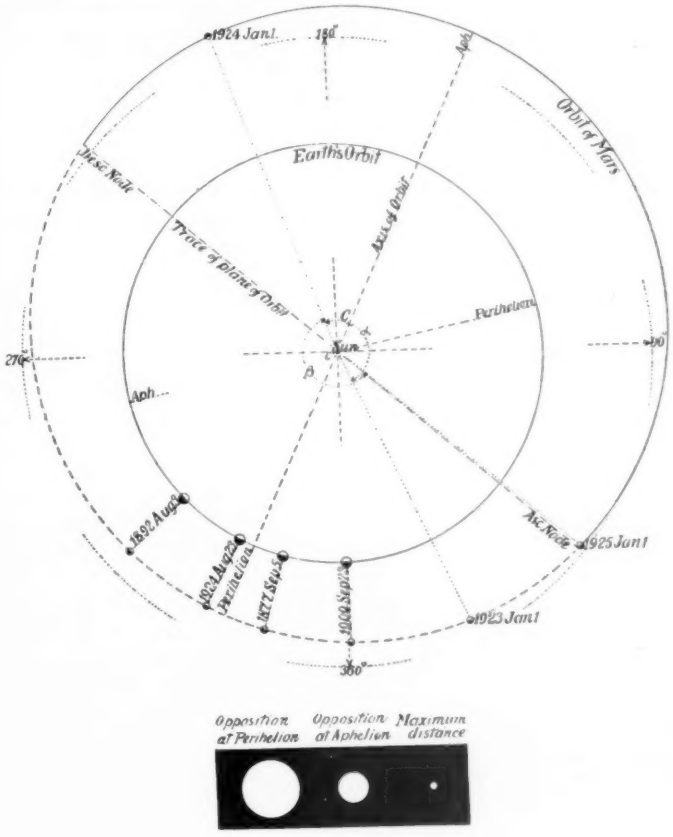
The recurrence this year of an opposition of Mars which is very favorable for observation suggests a comparison of this with the perihelion oppositions which have preceded it. On account of the eccentricity of the orbit, oppositions may be grouped in two series, viz., those in which, at each succeeding opposition, the distance between the earth and Mars is diminished, and the apparent diameter increased; and those in which the distance is increased, and the diameter diminished. The opposition of August 23 is the last of the former series.

The orbit is inclined at a small angle to the plane of the ecliptic (1° 51′), and in a plot of these dimensions, its projection on that plane practically represents its true form. The longitude of perihelion gives the position of the axis; and the longitude of the node that of the line of nodes, or the trace of the plane of the orbit. The full line represents that part which is above the plane of the ecliptic. The center is at *C;* and the center of the earth's orbit at *c*.

The positions of Mars are represented for January 1, 1923, 1924, and 1925; and the effect of the eccentricity is shown by the increased velocity of the planet in that part of the orbit which includes perihelion (β) as compared with that which includes aphelion (α).

If the synodic period (2.13539) is multiplied by 7, the product is 14.9477, *i. e.,* very nearly 15 years. If it is multiplied by 8, the prod-

uct is 17.083—a little over 17 years. The positions of the earth and Mars are shown for the oppositions of September 5, 1877, the year in which Professor Asaph Hall discovered the satellites. The next opposition which was near perihelion occurred 15 years later—August 3, 1892; and that which followed in 17 years—September 23, 1909. The opposition this year, after another interval of 15 years, occurs on



August 23. That is to say, these oppositions have occurred at intervals alternately of 15 and 17 years. If the first and second periods be added, and these increased by the third, it will be seen that there is a gradual approach to a whole number of years; and the total interval between the opposition of 1877 and that of the present year differs a very little from 47 years. As a consequence the opposition of this year is very near that of 1877.

During its revolution around the sun the greatest diminution of the apparent size of the planet occurs before and after conjunction when the earth and Mars are separated by a distance which is nearly equal to the sum of the radii of the orbits of the planets, and the apparent diameter is diminished to about one-eighth of the maximum.

POLAR MOUNTINGS FOR REFRACTORS AND REFLECTORS.*

By C. J. LARSON, M. D.

Polar mountings with stationary eye-pieces have a great many advantages, especially for the amateur who does not wish to bundle himself up and endure the cold of winter observations.

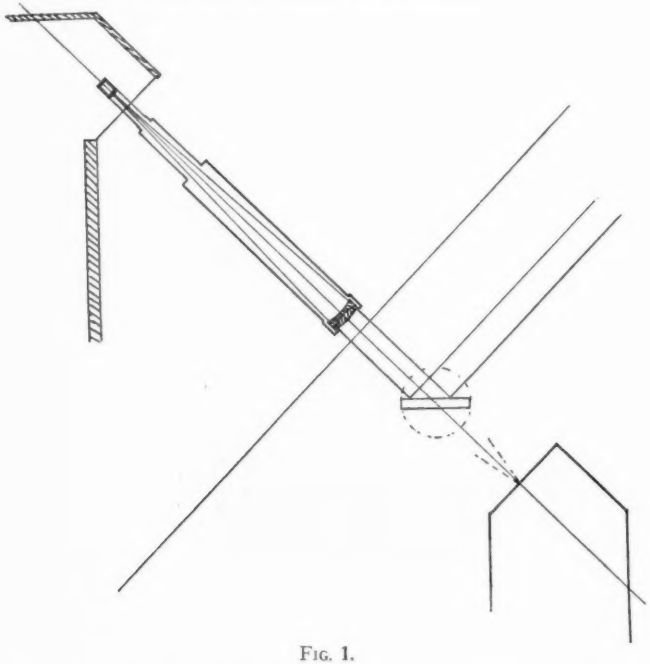


FIG. 1.

Many interesting articles have appeared in POPULAR ASTRONOMY,

*A paper found among the effects of Dr. Larson after his death, on January 11, 1923, addressed to POPULAR ASTRONOMY. Dr. Larson was much interested in astronomy and was a highly appreciative reader of our magazine.—ED.

most of them by Mr. Russell Porter. The only original arrangement proposed by the present writer is a modification of the Coudé for reflectors. The three figures show respectively the Gerrish refractor, the Coudé refractor and the Coudé modification for reflectors.

In the Gerrish mounting the light is reflected into the telescope by a flat, objects of various declinations being reached by tilting the flat, and movements in right ascension made by rotating the entire mounting about the polar axis, or the flat alone. Fig. 1 shows the plan of the mounting. In the Coudé (Fig. 2), there are two reflecting planes, and while different right ascensions are attained by rotating the entire

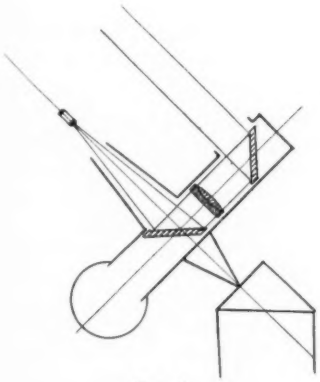


FIG. 2.

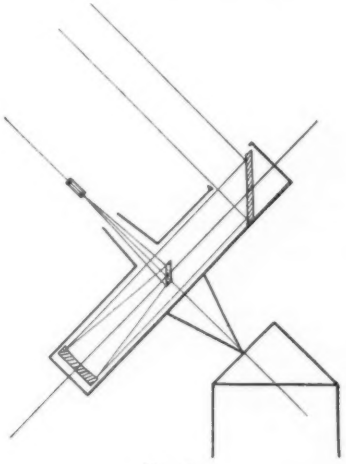


FIG. 3.

mounting, the declinations are reached by a rotation of the reflecting plane placed furthest out, this rotating about an axis at right angles to the polar axis. A counterweight is used to balance the cross arm.

In Fig. 3 is shown the modified Coudé for reflectors. In place of the counterweight we have the paraboloid reflector, and in place of the central plane we have the smaller diagonal. Movements about the polar axis are as in the refractor, while declination movements may be of the outer plane alone, or of the tube, or cross arm, with the paraboloid reflector, while the diagonal flat must remain at rest as in the refractor.

In the Gerrish telescope the circumpolar region is shut off from view, a comparatively small area, however. In the Coudé objects in this region are out of view only at lower culminations. The writer experimented with a modified Gerrish enabling one to reach even the polar region, but the amateur may not be so interested in that slightly more complicated construction. The plan may be offered later.

Think of sitting down in a warm room, any clear night, or day, and viewing the objects in the sky as you would look through a book or at a drawing!

The figures are not drawn to any particular scale, are mechanically imperfect, and purely diagrammatic.

Negaunee, Michigan,
Nov. 20, 1922.

THE REFORM OF THE PRESENT CALENDAR.

By H. JAMESON.

The scheme that Mr. Rigge advocates, in his article "The Reform of the Present Calendar begun," (POPULAR ASTRONOMY, March, 1924), has grave disadvantages from more than one point of view.

In the collection and discussion of meteorological and many other statistics, "monthly means" play an important part. Although the irregular calendar month is not, for scientific purposes, an ideal subdivision of the year, its faults are not sufficient to outweigh the advantages of a unit so familiar to the general public. These monthly means, would, however, lose all their significance, if the calendar month did not, year after year, remain in nearly the same position relative to the tropical year. With the present calendar, the range of this position for any one month is a day only, over a short period of years, except at the end of a century, when it may be nearly two days, and even over a long period of years it is less than two days. A range of this size is unavoidable, and is not large enough to affect very materially the value of monthly statistics.

Under the scheme of intercalated weeks, however, the range over even a small number of years would be a week, while at the middle or end of a century it would be eleven days (or even seventeen, but as regards this point see below), and the range over a large number of years would be eleven days. There would, moreover, be an odd week of statistics every fifth year, which could not be as easily disposed of as is the odd day in leap year at present. The present convenient system of collecting and presenting data by calendar months would have to be given up, at any rate in the case of climatological and other scientific statistics, and suitable units chosen, with reference not to the calendar, but to the tropical year. This would not only entail much additional work in the preparation of these figures, but would greatly diminish their value to the general public.

Searle's scheme could not fail to cause much inconvenience, too, in ordinary business life. For example, is the same yearly rent to be

paid for a house or for business premises, over a year of 53 weeks as over one of 52? Will a man on a yearly salary receive the same for 52 weeks as for 53? His expenses will be appreciably higher in leap year. I can foresee difficulties, too, with the income-tax collector, regarding the assessment of the yearly profits of a business. An extra day in leap year might be passed over without adjustment, but hardly an extra week.

Where accounts are kept, and salaries paid, monthly, the extra week would also tend to complicate matters, and to create confusion.

It might be objected, that the present calendar months vary in length among themselves, and that, nevertheless, no difficulty is experienced in keeping monthly accounts, or in paying monthly salaries. Why then should there be any difficulty in variable years? But over a very few months, the variation in the length of a month practically averages out, while it would take five years to average out the variation in the year.

I cannot see that these objections to an intercalated week are in any way balanced by the merely sentimental advantage of unbroken weeks, plus perhaps a slight advantage to historians of the future in checking their dates. No reform of the calendar can be considered satisfactory, which varies the length of the calendar year, or its position relative to the tropical year, more than the minimum absolutely necessary.

One detail of the scheme quite unnecessarily increases its faults. I refer to the provision for placing the ninth exception to leap year at the beginning of a cycle. Mr. Rigge quotes the rule, "Every year whose number ends in a 5 or a 0 is a leap year, except when it ends in a 50 or a 00, and when it begins a new cycle." If a new cycle begins with the year 2001 this means that there will be no leap year between 1995 and 2010, both 2000 and 2005 being exceptions. The calendar year over that period will have a range of over seventeen days relative to the tropical year, so that, (if we assume that the intercalated week comes at the end of leap year), the May of 2010, for example, will more nearly correspond to the April of 1996, as regards the seasons, than to the May of that year. The interval between leap years should never exceed ten years. The most suitable place for the ninth exception would be midway between two others. The rule, for example, might read "Every year whose number ends in a 5 or a 0 is a leap year, except when it ends in a 50 or a 00, and except the first year of a new cycle that ends in 25."

Colombo Observatory, Ceylon.
April 28, 1924.

THE DISTRIBUTION OF THE STARS.*

By HARLOW SHAPLEY.†

The distribution of stars is recognized as fundamental in the study of galactic structure. In particular, the problems that are founded on stellar distribution include the relative frequency of various evolutionary stages of stars, the general space density, the superficial density, and the relation of all these properties to distance from the sun and position in the sky. The discoidal form of our stellar system has long been accepted. The changing ideas concerning the dimensions of the system and the interrelation of its various components have not affected the belief that in the direction of the Milky Way the sidereal organization is much more extended than in directions highly inclined to the galactic plane. The discoidal form complicates the analysis of stellar distribution. Still more complicating is the eccentric position of the sun, and the obviously non-homogenous character of the neighboring parts of the stellar system.

The point that stands out most clearly, after a considerable investigation of stellar distribution, is the restricted value that must be attached to any analysis that does not recognize the heterogeneity of the neighborhood. Some general studies have recently been made in which galactic latitudes were not differentiated, thus ignoring the discoidal form of the stellar system. Many recent studies have failed to differentiate with respect to galactic longitude, thus largely ignoring the sun's eccentric position and the conspicuous clusters and star clouds, some of which are near at hand. I believe that we are on the edge of the great Cygnus star cloud, and that the preferential drift of rapidly moving stars away from the Cygnus region may be an indication and measure of the velocity of that stellar organization with respect to the galactic system and our local cloud. The studies of stellar distribution should recognize clearly that integrated and undifferentiated results refer to a mixture, in unknown proportions, of the stars of various streams and semi-independent clusters, chief of which is the local system outlined by the brighter B stars.

Equally important, in the analysis of stellar distribution in this neighborhood, are the large obscuring nebulosities in Taurus, Ophiuchus, Sagittarius and elsewhere, most of which appear to be only a few hundred parsecs distant. The great rift in the Milky Way from Aquila southward through Sagittarius has long been recognized as an

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†Director of Harvard College Observatory.

obscuring cloud; it is near enough to affect seriously the distribution of stars brighter than the tenth magnitude.

Although the lack of homogeneity in the galactic system will seriously disturb attempts to make close analyses of structure and concentration on the basis of general star counts, nevertheless, a study of the numbers of stars of various spectral types and in different galactic regions leads to deductions of interest in the structural problem. The investigation of the spectra of stars during the last thirty years at Harvard has yielded finally the Henry Draper Catalogue, which contains in nine volumes the positions, magnitudes and spectral classes of a little more than 225,000 stars, classified by Miss Annie J. Cannon. The survey covers the whole sky and extends in places to the tenth magnitude and fainter. Indirectly the catalogue is a source for information concerning stellar distances, and therefore can be used to some extent as shown below for the examination of the distribution of stars in space; but it chiefly serves to indicate the distribution on the surface of the sky.[1] A few of the more general results are described in the present account.

The stars have been grouped into eleven general classes. About 99 per cent. of them fall into the familiar classes B, A, F, G, K, and M, which is a series in the order of decreasing surface brightness and also in the order of progressive change in average color from reddish toward blue. It is of interest that about 20,000 of these stars have spectra so nearly identical with that of the sun that no difference could be seen on the small spectrographic dispersions used for faint objects. The most common classes are A and K, especially in the Milky Way, but it must be remembered that this condition refers to the apparent distribution, since the selection of stars for the catalogue is on the basis of apparent brightness rather than absolute brightness or distance. If we were dealing with a unit of volume rather than a unit of surface we should find, as is well known, a much different condition; instead of the highly luminous giant stars of Classes A and K predominating, we should find that dwarf stars are extremely more numerous than giants. It is also probable that Divisions K and A are long periods in the evolutionary sequence.

Probably one of the most important results of the discussion of the Henry Draper Catalogue relates to this matter of relative numbers in space. We now know the average real brightness of the stars of several spectral classes and also know that the dispersion about the average is small. For such classes the apparent brightness decreases with the distance from the observer, and is, indeed, a valuable measure-

[1]The Henry Draper Catalogue is contained in volumes **91** to **99** inclusive, of the Harvard Annals. Various discussions of the material have appeared since 1921 in Harvard Circulars 226, 229, 230, 239, 240, 245, 248 and in Harvard Bulletins 787, 792, 796. A detailed summary of the investigation of stellar distribution is published in the Proceedings of the American Academy of Arts and Sciences for 1924.

ment of the distance. We find that the highly luminous Class B stars appear in the Henry Draper Catalogue, with apparent magnitudes brighter than 8.25, when at distances up to 880 parsecs (three thousand light years). But dwarf G stars, such as the sun, must be nearer than 70 parsecs to appear brighter than magnitude 8.25. It happens that the number of B's and dwarf G's on the surface of the sky, in the direction of the Milky Way, are nearly the same, although the volume throughout which the former can be seen is nearly two thousand times as great. We therefore conclude that stars in the phase of development of our sun are actually eighteen hundred times as numerous as the highly massive and luminous B stars, which we believe to be in an earlier stage of evolution. In a similar way we find that the youngest of all luminous stars, the giant M's, now appear but once in space for every 350 solar stars. That there are four or five times as many giant M stars as B stars suggests that few have sufficient mass to attain the highest surface temperatures.

The following tabulation gives the surface and space numbers for those classes where the mean absolute magnitudes can be assumed with some certainty. The second column contains the numbers of stars in a hundred square degrees brighter than visual magnitude 8.25 and therefore within the distance limits computed for the third column. The last column gives the number of stars in a million cubic parsecs. Dwarf stars of Classes K and M are likely to be much more numerous than the dwarf G stars.

Spectral Division	Surface Number	Distance Limit	Space Number
Giant M.....	17.5	430	22
Giant K.....	69.0	350	160
B.....	29.7	880	4.4
A.....	96.9	340	250
Dwarf F.....	18.7	140	680
Dwarf G.....	26.0	70	7600

Only the region in low galactic latitudes has been used in the above computation, since in that direction (taking all longitudes together) the change of space density with distance can be ignored in a first approximation. The space explored for the B stars is about 1.5×10^8 cubic parsecs, indicating that the material used is of considerable weight and better represents this part of the galactic system than the similar analyses based on stars within ten parsecs of the sun.

The fact that most of the stars in this part of the galactic system are in the extreme dwarf stage, suggests that the evolution through known spectral types is chiefly a matter of the past; or much more probably it indicates that the changes proceed more slowly throughout the dwarf series than in the early giant stages of low internal density. The relation of speed of development to mass is also involved in the question. Possibly we have only an indication here that large masses are infrequent, and that average and small masses evolve rapidly in

early life. But obviously the observed fact is much more certain than any of these suggested interpretations.

Some of the fainter stars in the catalogue are at distances in excess of 3,000 parsecs; such are the stars of Class B fainter than the elev-

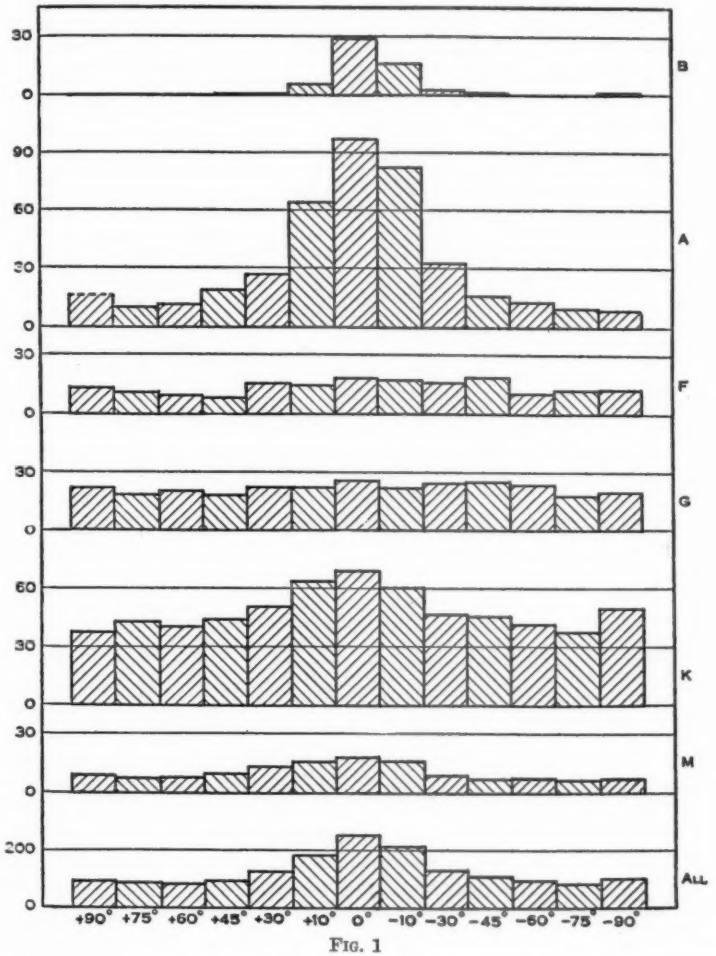


FIG. 1

enth visual magnitude and Cepheid variables fainter than the ninth and tenth magnitude. But as a striking illustration of the small portion of the galactic system to which our spectroscopic studies are limited, we may observe that probably more than 95 per cent. of the stars of all classes and magnitudes in the Henry Draper Catalogue are

within 1,000 parsecs of the sun. Only about one millionth of the space known to be closely populated with stars is covered at all well by this extensive compilation of spectra.

It appears, however, that the edges of the stellar system are approached in high galactic latitudes for giant stars of all classes. A distinct concentration to the galactic circle is deduced for the B, A, K, and M stars brighter than visual magnitude 8.25 (the limit of completeness of the catalogue). Stars of Classes F and G, however, are very little concentrated, because they are chiefly dwarfs and only those near at hand, in the region of relatively uniform space density, appear in the catalogue.

Figure 1 illustrates the galactic concentration for the different spectral classes. The ordinates for each diagram are the numbers of stars

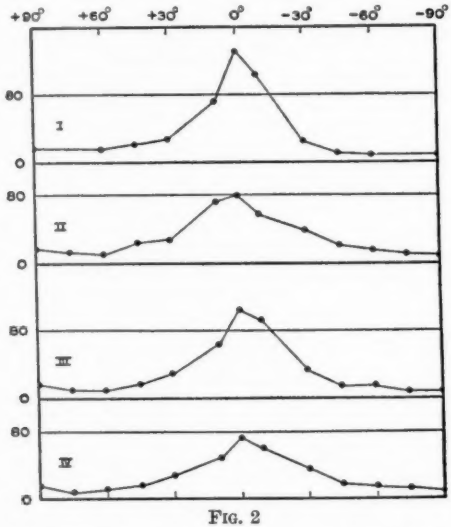


FIG. 2

in a region of one hundred square degrees; the abscissas are galactic latitudes. The diagrams illustrate not only the concentration but also, when read vertically, they show the relative frequency of the various spectra in different zones.

The most striking feature of Figure 1 is the contrast in galactic concentration between Classes A and F. The former includes subtypes from B8 to A3, and the latter, subtypes from A5 to F2. A closer analysis of the data shows that the rapid change in concentration lies between A0 and A5. This change indicates a very rapid decrease with advancing type in the average absolute brightness of the stars.[2] It suggests that the spectral differences among the early subtypes of

[2] Harvard Bulletin 796, 1923.

Class A may be better regarded as criteria of absolute magnitude than of color and surface temperature. The B stars and early A's are probably concentrated to the galactic plane more than later classes.

In Figure 1 all longitudes were taken together. Figure 2 shows that in different longitudes the A stars brighter than 8.25 differ greatly in galactic concentration. The upper curve shows the concentration in the first quarter of galactic longitude, where the star clouds in Cygnus appear to affect the distribution. The second quarter is affected in low latitudes by the obscuring nebulosities in Taurus and vicinity. The third quarter covers the region of the center of the local system, and the fourth quarter records impressively the influence of the rift in the Milky Way on the distribution of these giant stars of Class A. Since stars brighter than the seventh magnitude also show the rift slightly, we compute that its nearer border may be not more than 200 parsecs distant.

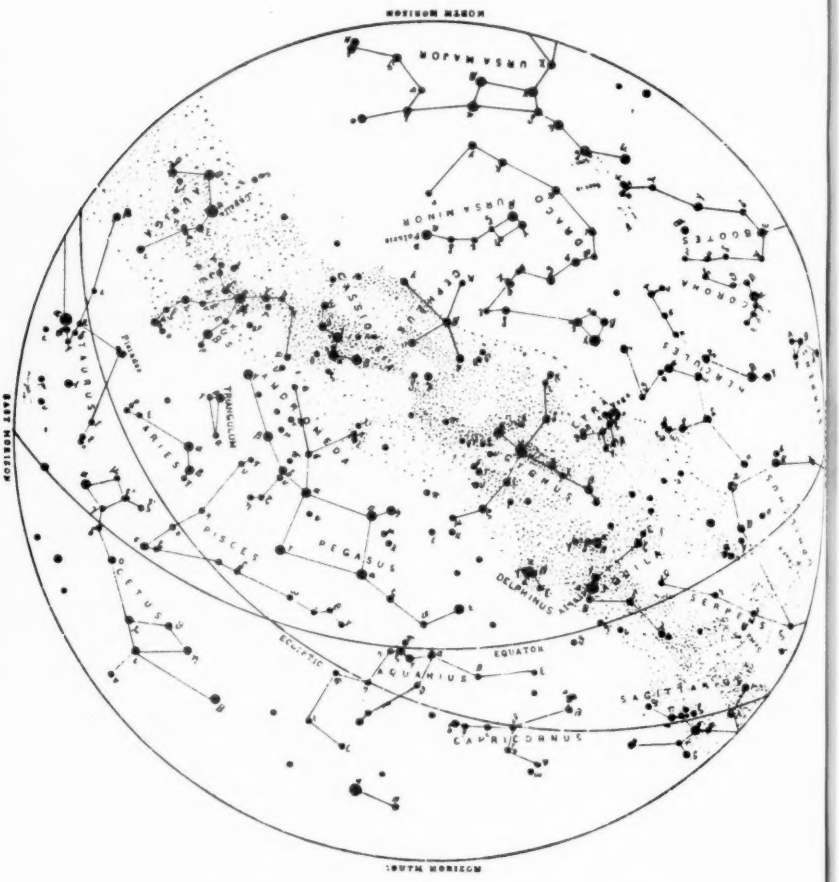
The stars of Class A brighter than magnitude 6.5 are distributed with remarkable uniformity in galactic longitude. The bright B stars, however, show the center of the local system in the constellation Carina. They also indicate clearly that the central plane of the local system is inclined between ten and fifteen degrees to the galactic plane. But the B stars fainter than the eighth magnitude are almost exclusively members of the general galactic system and are highly concentrated to the galactic circle.

When we examine the distribution of the more distant stars, the greater richness of the Sagittarius region is revealed. For instance, the variable stars of Class M are now recognized as giants at maximum brightness; hence, when the maximum apparent magnitude is faint, they are very remote. They are found to be four times as numerous in the direction of Sagittarius, toward the center of the Galaxy, as in the opposite direction. Similar preference is shown by planetary nebulae, O-type stars, Cepheid variables, the faint B stars and the novae.

The high concentration of faint stars in low galactic latitudes emphasizes the importance of the study of spectra in the Milky Way. Systematic extension of the Henry Draper Catalogue is now being made to fainter stars. But this extension will not attempt to cover the whole sky. Special attention will be given to fields along the Milky Way, particularly those in the northern sky for which the magnitude limit in the catalogue is between eight and nine. In one such field in Aquila Miss Cannon has now recorded 1,567 spectra, of which less than 200 have previously been classified.

PLANET NOTES FOR SEPTEMBER AND OCTOBER.

The *Sun* will move southeastward during these two months. On September 1 its position will be $10^h\ 41^m$, $+\ 8°\ 17'$ and on October 31, $14^h\ 22^m$, $-14°\ 7'$. It



THE CONSTELLATIONS AT 9:00 P. M. OCTOBER 1, 1924.

will cross the equator from north to south on September 22. This event marks the time of the autumnal equinox and the beginning of the autumn season. Its path will lie from Leo through Virgo into Libra. About the middle of October it will pass very near to the bright star Spica, α Virginis.

The phases of the *Moon* will occur as follows:

First Quarter	Sept.	6 at	3 A. M.	C.S.T.
Full Moon		13 "	1 A. M.	"
Last Quarter		20 "	10 P. M.	"
New Moon		28 "	2 P. M.	"
First Quarter	Oct.	5 at	9 A. M.	C.S.T.
Full Moon		12 "	2 P. M.	"
Last Quarter		20 "	5 P. M.	"
New Moon		28 "	1 A. M.	"

The *Moon* will be at perigee, nearest the earth, on September 7, October 2 and October 29; it will be at apogee, farthest from the earth, on September 20 and on October 18.

Mercury will pass the sun from east to west on the side toward the earth on September 11. It will reach a point of greatest elongation west of the sun on September 27. On and near this date it will rise a little more than an hour before the sun at a point about five degrees north of the point at which the sun rises. After this date its motion will again be eastward toward the sun, and it will pass the sun on the side opposite to the earth on October 25. At this time it is said to be in superior conjunction with the sun, and is, of course invisible in the rays of the sun.

Venus will reach a point of greatest elongation west of the sun on September 10. At this time it will rise more than three hours before the sun, and will be a brilliant object in the morning sky. It will continue to be a morning star throughout these two months. It will be receding from the earth and will be becoming slightly fainter. It will, however, be much brighter than any star in the sky.

Mars, having passed opposition to the sun and its point nearest the earth in the latter part of August will continue to be favorably situated for observation during these two months. At the end of October it will cross the meridian about eight o'clock in the evening. By the end of October it will have moved from a distance less than 35,000,000 miles, its nearest approach, to a distance of more than 60,000,000 miles from the earth. Its stellar magnitude will have changed from —2.7 on August 22 to —0.9 on October 31; that is, it will be 1.8 magnitudes fainter.

Jupiter will be in quadrature, 90° east of the sun, on September 3. It will then be on the meridian at six o'clock in the evening, and after that earlier from day to day. It will therefore be in position for observation during September, but will be rather too low in the west during October.

Saturn will be visible in the western sky in September. In October it will be quite near the sun and will be in conjunction with the sun on October 28.

Uranus will be in opposition to the sun on September 12. It will therefore be well situated during this period. It will be in the western part of the constellation Pisces in a region free from bright stars.

Neptune will be visible only in the early morning. At the end of October it will be on the meridian about seven o'clock in the morning.

Occultations Visible at Washington.

[*From the American Ephemeris*]

Date 1924	Star's Name	Magnitude	IMMERSION. Washington M.T.	IMMERSION. Angle from N	EMERSION. Washington M.T.	EMERSION. Angle from N	Duration
			h m	°	h m	°	h m
Sept. 2	88 Virginis	6.5	8 18	68	9 2	325	0 44
4	γ Librae	4.0	6 46	108	8 0	281	1 14
10	44 Capricorni	6.0	13 29	110	14 17	206	0 49
14	26 Ceti	6.0	8 28	108	9 18	206	0 50
14	33 Ceti	6.1	13 8	55	14 33	246	1 25
16	μ Ceti	4.4	11 21	33	12 25	277	1 3
17	*f* Tauri	4.3	9 49	79	10 50	241	1 1
18	γ Tauri	3.9	10 5	72	11 4	254	0 59
18	70 Tauri	6.4	13 18	104	14 26	216	1 8
18	75 Tauri	5.2	15 22	64	16 54	260	1 32
18	α Tauri (*Ald.*)	1.1	20 47	117	21 46	233	0 59
Oct. 4	16 Sagittarii	5.9	4 27	101	5 49	267	1 22
6	π Capricorni	5.2	11 36	107	12 27	221	0 51
12	ν Piscium	4.7	13 44	11	14 35	296	0 51
21	π Cancri	5.6	16 32	160	17 17	225	0 45
22	ν Leonis	5.0	12 18	111	13 11	268	0 52
22	α Leonis (*Reg.*)	1.3	17 36	96	18 58	305	1 23
31	16 G Sagittarii	6.4	6 14	83	7 22	272	1 7

Phenomena of Jupiter's Satellites.

VISIBLE AT WASHINGTON.

[From the *American Ephemeris.*]

CENTRAL STANDARD TIME, NOON = 0^h

1924	h m			1924	h m		
Sept. 2	8 54	I	Tr. I.	Sept. 12	8 15.9	II	Ec. D.
3	8 11	II	Tr. I.	14	6 56	III	Oc. D.
4	6 52	I	Sh. E.	18	7 16	I	Tr. I.
5	8 7.6	II	Ec. R.	19	7 53.3	I	Ec. R.
7	8 4.2	III	Ec. D.	21	7 38	II	Sh. E.
10	8 1	I	Oc. D.	25	5 57	III	Sh. I.
11	6 35	I	Sh. I.	26	6 23	I	Oc. D.
	7 30	I	Tr. E.	27	5 55	I	Tr. E.
12	5 58.3	I	Ec. R.		7 7	I	Sh. E.
	8 8	II	Oc. R.				
Oct. 4	5 42	I	Tr. I.	Oct. 20	5 9	I	Sh. I.
	6 50	I	Sh. I.		6 23	I	Tr. E.
5	6 11.9	I	Ec. R.	23	4 50	II	Sh. I.
13	5 26	I	Sh. E.		5 26	II	Tr. E.
	6 46.3	III	Ec. R.	30	5 44	II	Tr. I.
14	5 55	II	Oc. D.				

VARIABLE STARS.

Minima of Variable Stars of Short Period.

[Calculated by members of the class in General Astronomy at Carleton College.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1924					
					Sept.				Oct.	
	h m	° ′		d h	d h	d h	d h	d h	d h	d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.8		16 2			21 0	
RT Sculptor.	31.5	—26 13	9.6—10.5	0 12.3	5 8	20 17	6 1	21 9		
U Cephei	0 52.4	+81 20	7.0— 9.0	1 11.8	5 6	20 5	5 4	20 3		
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	6 21	19 2	7 11	19 16		
TW Cassiop.	37.6	+65 19	8.2— 9.0	1 10.3	6 19	23 22	11 2	28 5		
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	5 22	19 16	10 6	23 23		
RZ Cassiop.	39.9	+69 13	6.9— 8.1	1 04.7	5 12	19 20	4 4	18 12		
TX Cassiop.	44.4	+62 22	9.4—10.1	2 22.2	5 9	22 22	10 12	28 1		
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	4 7	20 5	6 2	21 23		
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6	9 20		12 3			
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	7 6	24 11	11 15	28 20		
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	9 15	23 5	6 19	20 9		
λ Tauri	55.1	+12 12	3.3— 4.2	3 22.9	7 18	23 13	9 9	25 4		
RW Tauri	3 57.8	+27 51	7.1— [11	2 18.5	8 14	25 5	11 20	28 11		
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	7 22	23 17	9 12	25 6		
RW Persei	13.3	+42 04	8.8—11.0	13 04.8	1 14	27 23	11 4	24 9		
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	6 11	19 2	7 23	20 13		
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	4 19	29 15	12 1	24 11		
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	3 22	17 6	7 6	20 14		
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	6 19	23 4	9 12	25 21		
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	5 11	23 13	5 14	23 15		
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	2 6	19 14	6 22	24 6		
Z Orionis	50.2	+13 40	9.7—10.7	5 04.9	6 10	27 6	7 15	28 11		
SV Gemin.	54.6	+24 28	9.8— [11	4 00.2	9 14	25 14	11 15	27 15		
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	4 16	21 21	9 1	26 6		
U Columbæ	6 11.2	—33 03	9.2—10.0	2 19.2	5 5	22 0	8 19	25 15		
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	2 11	18 21	5 6	21 16		
RW Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	2 19	18 1	3 7	26 4		
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	8 17	20 22	3 3	27 13		
RU Monoc.	6 49.4	— 7 28	9.8—10.5	0 21.5	2 21	17 6	1 13	23 2		
R Can. Maj.	7 14.9	—16 12	5.8— 6.4	1 03.3	10 0	23 15	7 6	20 21		
RY Gemin.	21.7	+15 52	8.9— [10	9 07.2	3 18	22 8	10 23	29 13		
Y Camelop.	27.6	+76 17	9.5—12	3 07.3	5 21	25 17	8 22	22 3		
TX Gemin.	30.3	+17 08	10.0—11.9	2 19.2	2 17	19 12	6 8	23 3		
RR Puppis	43.5	—41 08	9.4—10.7	6 10.3	7 12	20 9	3 5	22 12		
V Puppis	7 55.4	—48 58	4.1— 4.8	1 10.9	2 17	17 6	1 19	23 14		
X Carinae	8 29.1	—58 53	7.9— 8.7	0 13.0	5 1	21 7	7 13	23 19		
S Cancri	8 38.2	+19 24	8.2—10	9 11.6	9 16	28 15	8 3	27 2		
RX Hydrae	9 00.8	— 7 52	9.1—10.5	2 06.8	7 2	20 18	4 11	18 4		
S Velorum	29.4	—44 46	7.8— 9.3	5 22.4	5 6	17 3	4 22	22 18		
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	7 17	21 4	11 10	24 22		
RR Velorum	10 17.8	—41 36	10.0—10.9	1 20.5	7 13	22 9	7 5	22 1		
SS Carinæ	10 54.2	—61 23	12.2—12.8	3 07.2	7 10	20 14	10 10	23 15		
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	8 0	25 14	13 5	30 19		
RW Urs. Maj.	35.4	+52 34	10.3—11.4	7 07.9	7 16	22 8	7 0	21 16		
Z Draconis	1 39.8	+72 49	9.9—13.6	1 08.6	6 12	20 2	10 10	24 1		
RZ Centauri	12 55.6	—64 05	8.5— 8.9	1 21.0	6 19	21 19	14 7	29 8		
RS Can. Ven	13 06.3	+36 28	7.5—12.5	4 19.1	1 1	20 14	9 16	28 23		
SS Centauri	07.2	—63 37	8.8—10.4	2 11.5	8 7	23 4	8 1	22 22		
SX Hydræ	13 39.0	—26 23	8.6—12.7	2 21.5	4 19	22 4	3 18	21 3		

Minima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in 1924							
					Sept.				Oct.			
	h m	° ′		d h	d h	d h	d h	d h	d h	d h	d h	d h
δ Libræ	14 55.6	— 8 07	4.8— 6.2	2 07.9	3 7	17 6	8 5	22 4				
U Coronæ	15 14.1	+32 01	7.6— 8.7	3 10.9	10 1	23 21	7 16	21 12				
TW Draconis	15 32.4	+64 14	7.3— 8.9	2 19.4	7 18	24 15	11 11	26 7				
SS Libræ	15 43.4	—15 14	9.3—11.5	0 18.4	4 5	18 14	2 23	24 13				
SW Ophiuchi	16 11.1	— 6 44	9.2—10.0	2 10.7	4 18	19 10	11 11	26 3				
SX Ophiuchi	12.6	— 6 25	10.5—11.2	2 01.5	3 3	19 16	14 10	30 22				
R Aræ	31.1	—56 48	6.8— 7.9	4 10.2	5 19	23 12	2 8	20 1				
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1		18 14	9 8	30 2				
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	3 6	23 15	7 6	20 20				
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	4 7	21 1	7 20	24 15				
η Herculis	13.6	+33 12	4.6— 5.4	2 01.2	7 23	20 7	8 18	21 1				
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	9 14	21 23	10 12	21 20				
RV Ophiuchi	29.8	+ 7 19	9. —12	3 16.5	5 6	20 0	4 18	19 12				
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	5 18	22 3	8 12	24 20				
TX Scorpii	48.6	—34 13	7.5— 8.2	0 22 6	6 22	22 0	7 2	22 4				
UX Herculis	49.7	+16 57	8.8—10.5	1 13.2	4 14	20 2	5 13	21 1				
Z Herculis	53.6	+15·09	7.1— 7.9	3 23.8	1 14	17 14	3 13	19 12				
WX Sagittarii	53.6	—17 24	9.2—10 8	2 03.1	6 8	23 9	10 9	27 10				
WY Sagittarii	17 54.9	—23 01	9.5—10.6	4 16.0	6 11	20 11	9 4	23 4				
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	9 19	25 8	10 20	26 8				
RS Sagittarii	11.0	—34 08	5.9— 6.3	2 10.0	7 2	21 14	6 2	20 13				
V Serpentis	11.1	—15 34	9.5—11.1	3 10.9	8 15	22 10	6 6	20 2				
RZ Scuti	21.1	— 9 15	7.4— 8.3	15 03.2	13 19	28 23	14 2	29 5				
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	6 22	21 6	5 13	19 21				
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	4 21	19 2	3 8	24 16				
SX Sagittarii	39.7	—30 36	8.7— 9.8	2 01.8	8 23	25 13	12 4	28 19				
RR Draconis	40.8	+62 34	9.3—13	2 19.9	4 16	21 15	8 15	25 15				
RS Scuti	43.7	—10 21	9.3—10.3	0 15.9	5 11	18 18	8 16	21 23				
β Lyræ	46.4	+33 15	3.4— 4.1	12 21.8	3 7	29 3	12 0	24 22				
U Scuti	18 48 9	—12 44	9.1— 9.6	0 22.9	5 10	20 16	5 23	21 6				
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.4	4 21	20 0	5 4	20 7				
RV Lyræ	12.5	+32 15	11. —12.8	3 14.4	7 19	22 4	6 14	20 23				
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	3 4	21 1	8 23	26 21				
U Sagittæ	14.4	+19 26	6.5— 9.0	3 09.1	1 5	21 12	5 1	18 13				
Z Vulpec.	17.5	+25 23	7.3— 8 5	2 10.9	5 17	20 10	5 4	19 21				
TT Lyræ	24.3	+41 30	9.4—11.6	5 05.8	9 4	24 21	10 15	21 3				
UZ Draconis	26.1	+68 44	9.0— 9.8	1 15.1	6 17	19 18	9 8	22 9				
SY Cygni	19 42.7	+32 28	10. —12	6 00.2	8 8	20 9	8 9	20 9				
WW Cygni	20 00.6	+41 18	9.3—13.4	3 07.6	9 2	22 8	5 15	18 21				
SW Cygni	03.8	+46 01	9. —11.7	4 13.8	8 21	22 15	6 8	20 1				
VW Cygni	11.4	+34 12	9.8—11.8	8 10.3	8 2	24 23	11 19	28 16				
RW Capric.	12.2	—17 59	8.8—10.6	3 09.4	3 23	17 12	7 21	21 10				
UW Cygni	19.6	+42 55	10.5—13	3 10.8	9 1	22 20	6 15	20 10				
V Vulpec	32.3	+26 15	8.2— 9.8	37 19.0		16 0		23 18				
W Delphini	33.1	+17 56	9.4—12.1	4 19.4	8 0	27 5	6 20	26 1				
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	9 15	28 1	7 5	25 15				
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	4 12	22 12	10 11	28 10				
WZ Cygni	49.3	+38 27	9.9—10.8	0 14.0	5 22	21 2	6 7	21 12				
RR Vulpec	20 50.5	+27 32	9.6—11.0	5 01.2	1 17	21 22	2 1	22 5				
RY Aquarii	21 14.8	—11 14	8.8—10.4	1 23.2	7 13	23 7	9 1	24 18				
UZ Cygni	25.2	+43 52	8.9—11.6	31 07.3	10 14		11 21					
RT Lacertæ	21 57.4	+43 24	9.1—10.5	5 01.7	1 9	21 16	1 20	22 3				
RW Lacertæ	22 40.6	+49 08	10.2—11.2	5 04.4	5 3	20 16	6 5	21 19				
VW Pegasi	51.7	+32 42	10.0—10 6	5 06.4	7 23	23 19	9 14	25 9				
Y Piscium	23 29.3	+ 7 22	9.0—12.0	3 18.4	9 1	24 3	9 4	24 6				
TW Androm.	23 58.2	+32 17	8.6—11.5	4 02.9	5 5	21 17	8 4	24 16				

Maxima of Variable Stars of Short Period.

[Calculated by members of the class in General Astronomy at Carleton College.]

Given to the nearest hour in Greenwich mean time; to obtain Eastern Standard time subtract 5^h; Central Standard time 6^h, etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1924							
					Sept.				Oct.			
	h m	° ′		d h	d h		d h		d h		d h	
SX Cassiop.	0 05.5	+54 20	8.6— 9.2	36 13.7			26	18				
SY Cassiop.	0 09.8	+57 52	9.3— 9.9	4 01.7	5	9	21	16	7	23	24	5
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	5	21	21	8	6	20	22	8
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	4	7	19	3	3	22	18	17
V Arietis	2 09.6	+11 46	8.3— 9.0	0 23.8	8	10	24	7	10	4	26	1
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	7	6	22	21	8	11	24	1
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	11	23	28	9	14	18	31	4
SX Persei	4 10.2	+41 27	10.4—11.2	4 07.0	2	18	19	22	7	2	24	6
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	11	13	22	16	3	19	26	1
RX Aurigæ	4 54.5	+39 49	7.2— 8.1	11 15.0	6	16	29	22	11	13	23	4
SX Aurigæ	5 04.6	+42 02	8.0— 8.7	1 12.8	5	11	20	19	6	3	21	10
SY Aurigæ	05.5	+42 41	8.4— 9.5	10 03.3	8	9	28	16	8	19	29	1
Y Aurigæ	21.5	+42 21	8.6— 9.6	3 20.6	5	19	21	6	6	17	21	3
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	7	7	23	21	4	22	21	12
RS Orionis	6 16.5	+14 44	8.2— 8.9	7 13.6	3	18	18	21	4	1	19	4
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3	1	13	28	13			25	13
R Aurigæ	23.0	+30 33	5.1— 6.0	3 17.5	11	13	26	11	11	9	26	7
W Gemin.	29.2	+15 24	6.7— 7.5	7 22.0	11	1	26	21	12	17	28	13
ζ Gemin.	6 58.2	+20 43	3.7— 4.3	10 03.7	2	5	22	13	2	17	23	0
RU Camelop	7 10.9	+69 51	8.5— 9.8	22 06.5	4	18	27	1			19	7
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	9	1	30	22	10	20	26	17
V Carinae	8 26.7	—59 47	7.4— 8.1	6 16.7	9	9	22	18	6	4	19	13
T Velorum	8 34.4	—47 01	7.6— 8.5	4 15.3	3	2	21	16	10	5	28	18
V Velorum	9 19.2	—55 32	7.5— 8.2	4 08.9	5	11	22	22	10	10	26	21
Z Leonis	9 46.4	+27 22	7.9— 9.6	56 08.7	5	4					31	12
RR Leonis	10 02.1	+24 29	9.1—10.1	0 10.9	10	14	24	4	7	17	21	7
SU Draconis	11 32.2	+67 53	8.9— 9.6	0 15.8	11	14	26	19	8	0	21	5
S Muscae	12 07.4	—69 36	6.4— 7.3	9 15.8	10	4	29	11	9	3	28	11
SW Draconis	12.8	+70 04	8.8— 9.6	0 13.7	7	2	23	1	9	0	24	23
T Crucis	15.9	—61 44	6.8— 7.6	6 17.6	7	0	20	11	3	22	24	3
R Crucis	18.1	—61 04	6.8— 7.9	5 19.8	9	11	21	2	8	13	26	1
S Crucis	12 48.4	—57 53	6.5— 7.6	4 16.6	7	5	21	6	5	8	19	10
W Virginis	13 20.9	— 2 52	8.7—10.4	17 06.5	9	2	26	8	13	15	30	21
SS Hydræ	25.0	—23 08	7.4— 8.1	8 04.8	8	5	24	14	11	0	27	10
RV Urs. Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	10	19	24	20	8	21	22	22
ST Virginis	14 22.5	— 0 27	10.3—11.4	0 09.9	8	5	24	16	2	21	19	8
V Centauri	25.4	—56 27	6.4— 7.8	5 11.9	6	14	23	1	9	13	20	13
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	3	5	18	7	3	9	18	12
R Triang.Austr.	15 10.8	—66 08	6.7— 7.4	3 09.3	8	4	21	17	5	7	18	20
S Triang.Austr.	15 52.2	—63 29	6.4— 7.4	6 07.8	11	4	23	19	12	18	25	10
S Normæ	16 10.6	—57 39	6.6— 7.6	9 18.1	3	0	21	12	12	0	30	12
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	4	15	22	8	10	2	27	19
RV Scorpii	16 51.8	—33 27	6.7— 7.4	6 01.5	11	13	23	16	11	20	23	23
X Sagittarii	17 41.3	—27 48	4.4— 5.0	7 00.3	8	4	22	4	6	5	20	5
Y Ophiuchi	47.3	— 6 07	6.1— 6.5	17 02.9	5	10	22	12	9	15	26	18
W Sagittarii	17 58.6	—29 35	4.3— 5.1	7 14.3	9	9	24	14	9	18	24	23
Y Sagittarii	18 15.5	—18 54	5.4— 6.2	5 18.6	2	6	19	14	6	22	24	5
U Sagittarii	26.0	—19 12	6.5— 7.3	6 17.9	11	15	25	2	8	14	22	2
Y Scuti	32.6	— 8 27	8.7— 9.2	10 08.3	5	3	25	19	8	4	28	21
RZ Lyræ	39.9	+32 42	9.9—11.2	0 12.3	10	12	22	18	11	4	23	11
RT Scuti	18 44.1	—10 30	9.1— 9.7	0 11.9	10	14	22	11	10	7	22	5
κ Pavonis	18 46.6	—67 22	3.8— 5.2	9 02.2	1	4	19	9	1	13	25	18
U Aquilæ	19 24.0	— 7 15	6.2— 6.9	7 00.6	6	11	20	12	4	13	18	14
XZ Cygni	19 30.4	+56 10	8.6— 9.3	0 11.2	14	19	28	19	12	19	26	19

Maxima of Variable Stars of Short Period—Continued.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in 1924							
					Sept.				Oct.			
	h m	° ′		d h	d	h	d	h	d	h	d	h
U Vulpec.	32.2	+20 07	6.5— 7.6	7 23.5	10	15	26	14	12	13	28	12
SU Cygni	40.8	+29 01	6.2— 7.0	3 20.3	10	21	26	6	11	15	27	0
η Aquilæ	47.4	+ 0 45	3.7— 4.5	7 04.2	12	18	27	3	11	11	25	20
S Sagittæ	51.5	+16 22	5.6— 6.4	8 09.2	7	15	24	9	11	3	27	22
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	6	20	19	11	8	10	21	1
X Cygni	20 39.5	+35 14	6.0— 7.0	16 09.3	7	9	23	18	10	4	26	13
T Vulpec.	47.2	+27 52	5.5— 6.1	4 10.5	9	7	22	14	5	22	23	15
UY Cygni	52.3	+30 03	9.6—10.4	0 13.5	7	4	20	15	9	19	23	6
RV Capric.	55.9	—15 37	9.2—10.1	0 10.7	5	12	18	22	9	2	22	12
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	12	21	27	14	12	7	27	0
VY Cygni	21 00.4	+39 34	8.8— 9.5	7 20.6	4	18	20	11	14	0	29	18
SW Aquarii	10.2	— 0 20	9.9—10.8	0 11.0	6	21	27	13	11	8	25	3
VZ Cygni	21 47.7	+42 40	8.2— 9.2	4 20.7	7	17	22	8	6	22	21	12
Y Lacertæ	22 05.2	+50 33	9.1— 9.6	4 07.8	5	16	22	23	10	6	27	13
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	9	23	20	17	6	19	22	22
Z Lacertæ	36.9	+56 18	8.2— 9.0	10 21.1	11	19	22	17	3	14	25	9
RR Lacertæ	37.5	+55 55	8.5— 9.2	6 10.1	9	3	21	23	11	4	24	0
V Lacertæ	44.5	+55 48	8.5— 9.5	4 23.6	8	3	23	2	8	1	23	0
X Lacertæ	22 45.0	+55 54	8.2— 8.6	5 10.7	11	18	22	16	9	0	25	8
SW Cassiop.	23 03.7	+58 11	9.2— 9.7	5 10.6	9	0	25	8	11	15	22	12
RS Cassiop.	32.6	+61 52	9.0—11.0	6 07.1	9	19	28	16	11	7	23	20
RY Cassiop.	47.2	+58 11	9.3—11.8	12 03.4	12	7	24	10	6	13	30	20
V Cephei	23 51.7	+82 38	6.0— 7.0	0 23.9	8	20	22	19	6	19	20	18

Six New Variable Stars near N. G. C. 6723.—An examination of the region within about a degree and a half of the globular cluster N.G.C. 6723 has led to the discovery of six new variable stars. The cluster N.G.C. 6723 contains sixteen variables, as announced in Harvard Circular 33, 1898, and in Harvard Annals, **38**, 2, 1902. The variables in the cluster are reserved for later discussion. A study will also be made of the well-known stars R, S, and T Coronae Australis, and the involved nebulosity.

The material for these discussions is considerable, including forty-eight plates made with the 24-inch Bruce, thirty-one with the 13-inch Boyden, and twenty-seven with the 8-inch Bache telescope. The plates were made from 1889 to 1923. The new variables are as follows (positions for 1900):

H. V. 3734. $18^h\ 45^m\ 25^s$, —37° 26′.3. Maximum 14.5, Minimum 16.5.
Maximum = J. D. 2423635.72 + 0^d.4913 E

The above elements must be considered as somewhat in doubt, but a series of nine plates made on July 31, 1899, covering an interval of eight hours, also indicates a period of about half a day, and the above elements satisfy well the thirty-five observations obtained on Bruce plates in 1923.

H. V. 3735. $18^h\ 46^m\ 45^s$, —36° 12′.0. Maximum 14.5, Minimum 15.5.
Maximum = J. D. 2423635.55 + 8^d.034 E

H. V. 3736. $18^h\ 47^m\ 42^s$, —36° 38′.1. Maximum 14.0, Minimum [16.0.
Maximum = J. D. 2412655 + 90^d.4 E

The variable is the south following component of a rather close double star. The images of the two stars in general coalesce on the plates, and the light of both has been estimated in all cases.

H. V. 3737. $18^h\ 50^m\ 42^s$, —37° 55′.8. Maximum 10.0, Minimum [17.0.
Maximum = J. D. 2411510 + $347^d.5$ E

This star is well shown on the 8-inch Bache plates, when near maximum.

H. V. 3738. $18^h\ 53^m\ 12^s$, —35° 35′.3. Maximum 14.0, Minimum 15.5.
Maximum = J.D. 2415632.81 + $0^d.570026$ E

H. V. 3739. $18^h\ 53^m\ 36^s$, —35° 54′.5. Maximum 12.0, Minimum 13.5
Maximum = J. D. 2414125 + $64^d.1$ E

The following three variables were found at Arequipa, but had been announced previously by Innes in Union Observatory Circular, **38**, 303, 1917.

No. 74. $18^h\ 46^m\ 47^s$, —36° 14′.7. Maximum 11.0, Minimum 17.0. The observations on the Harvard plates appear to be best satisfied by the elements

Maximum = J. D. 2412765.0 + $28^d.0$ E

No. 130. $18^h\ 53^m\ 22^s$, —37° 3′.0. Maximum 14.5, Minimum 16.0. The Harvard observations are well satisfied by the elements

Maximum = J. D. 2412658.30 + $7^d.126$ E

It appears to be a Cepheid variable.

No. 159. $18^h\ 45^m\ 34^s$, —37° 27′.7. Maximum 13.5, Minimum 15.5. The observations are well satisfied by the elements

Maximum = J. D. 2414867.76 + $0^d.517012$ E

The position agrees closely with No. 159, but the elements are very different. Innes gives Maximum = J. D. 2420713 + 179^d. H. V. 3734 precedes this star only 9ˢ, 1′.4 north.

The variability of —37° 8450, discussed in Harvard Bulletin 780, is difficult of confirmation on these plates. No variation as great as a magnitude appears to be shown.

Harvard College Observatory Bulletin 803.

New Variable Star in Pavo, H. V. 3740.—The star whose position for 1900 is $20^h\ 9^m\ 15^s$, —60° 22′.1, has been found from an examination of chart plates by Miss Mabel A. Gill to be a variable of long period. The spectral class is M3e. The lines Hγ and Hδ are nearly equally bright. An examination of 144 photographs taken during the last thirty-four years, gives the following elements for the variation in light:

Maximum = J. D. 2411153 + 245^d E

The range in photographic magnitude is from 9.4 to [13.4.

Harvard College Observatory Bulletin 803.

COMET AND ASTEROID NOTES.

Numbering of Recently Discovered Asteroids.—In *Astronomische Nachrichten* No. 5290 the numbering of recently discovered minor planets, for which sufficient observations have been obtained to determine their orbits, has been extended to 995. The elements are given in the same number of the *Nachrichten*.

During the year July 1, 1922, to June 30, 1923, 37 discoveries of asteroids were announced. Five of these were identified with asteroids already listed, leaving 32 to be given new numbers.

The discoveries were distributed as follows:

Place	Discoverer	Number	Place	Discoverer	Number
Algiers	Jekhowsky	2	Simeis	Beljawsky	4
Arequipa	Bailey	1	Washington	G. H. Peters	1
Barcelona	Comas Solá	1	Vienna	Palisa	3
Bergedorf	Schwassmann	1	Williams Bay	O. Struve	3
Königstuhl	Reinmuth	13	Williams Bay	VanBiesbroeck	4
Königstuhl	Wolf	1			

Ephemeris of Encke's Comet.—I am sending you an Ephemeris of Encke's Comet for the summer and early autumn of 1924. It should be found by July in Aries in the morning sky.

EPHEMERIS OF ENCKE'S COMET.

Gr. Midnight 1924	α h m s	δ ° ′ ″	Log r	Log Δ
July 1	2 18 48	+21 13 24	0.31152	0.37044
5	2 26 6	+22 7 47	0.30242	0.35435
9	2 33 40	+22 53 19	0.29292	0.33749
13	2 41 33	+23 45 7	0.28302	0.31985
17	2 49 48	+24 38 9	0.27272	0.30141
21	2 58 29	+25 32 43	0.26192	0.28211
25	3 7 38	+26 28 39	0.25064	0.26191
29	3 17 24	+27 26 23	0.23876	0.24076
Aug. 2	3 27 11	+28 22 56	0.22636	0.21795
6	3 38 59	+29 26 20	0.21330	0.19561
10	3 51 6	+30 28 35	0.19954	0.17155
14	4 4 23	+31 32 4	0.18498	0.14645
18	4 19 2	+32 36 12	0.16956	0.12035
22	4 35 20	+33 40 6	0.15322	0.09332
26	4 53 31	+34 42 11	0.13580	0.06544
30	5 14 5	+35 40 2	0.11720	0.03693
Sept. 3	5 37 24	+36 29 53	0.09728	0.00812
7	6 3 51	+37 6 14	0.07586	9.97952
11	6 33 44	+37 21 31	0.05274	9.95187
15	7 7 7	+37 5 56	0.02764	9.92620
19	7 43 39	+36 8 9	0.00020	9.90388
23	8 22 19	+34 18 47	9.97014	9.88652
27	9 1 44	+31 32 19	9.93696	9.87588

The comet will be at perihelion October 31.894 G. M. T. and nearest the earth September 27, when the distance will be 0.751 earth's distance from the sun.

F. E. SEAGRAVE.

Definitive Elements of Comet 1917 I. — In the Swedish publication *Arkiv för Matematik, Astronomi och Fysik*, Band 18, No. 7, Mr. Sten Asklöf gives the results of a definitive calculation of the elements of the orbit of the comet 1917 I, discovered by Mellish at Leetonia, Ohio, March 19, 1917. The last observation was on June 24, 1917, at Cordoba, Argentina. From 186 observations, combined into seven normal places, Mr. Asklöf finds the following definitive elements:

$$\begin{aligned} T &= 1917 \text{ April } 10.674180 \text{ Gr. M. T.} \\ \omega &= 121^\circ\ 17'\ 46''.7 \\ \Omega &= 87\ 31\ 47.3 \quad 1917.0 \\ i &= 32\ 41\ 01.7 \\ \log q &= 9.279185 \\ \log e &= 9.996997 \\ \log a &= 1.440895 \\ \text{Period} &= 145.0 \pm 0.8 \text{ years} \end{aligned}$$

Monthly Report of the American Association of Variable Star Observers, April 20 to June 20, 1924.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
001032 S Sculptoris—						
	3854.9	10.5	Bl.	3880.3	10.8	Bl.
	3867.9	10.6	Bl.			
001046 X Andromedae—						
	3937.8	14.7	Wf.	3944.8	15.0	Wf.
	3939.8	15.1	Wf.			
001726 T Andromedae—						
	3943.8	12.7	Pt.			
001755 T Cassiopeiae—						
	3935.8	9.5	Ca.	3953.7	9.1	Ca.
	3943.8	9.4	Pt.			
001838 R Andromedae—						
	3943.8	9.5	Pt.	3948.8	9.6	Gb.
001862 S Tucanae—						
	3954.7	9.7	Bl.	3875.9	9.1	Bl.
	3867.9	9.2	Bl.	3903.9	10.2	Bl.
002546 T Phoenicis—						
	3875.9	10.9	Bl.	3903.9	9.1	Bl.
	3880.3	10.3	Bl.			
004047 U Cassiopeiae—						
	3894.6	11.1	Lv.	3937.8	13.8	Wf.
	3900.7	11.4	Wf.	3943.8	13.5	Pt.
	3911.7	11.7	Wf.	3944.8	13.7	Wf.
004435 X Sculptoris—						
	3854.9	12.6	Bl.	3875.9	11.9	Bl.
	3867.9	12.3	Bl.			
004746a RV Cassiopeiae—						
	3943.8	10.4	Pt.			
004958 W Cassiopeiae—						
	3899.6	8.5	Pt.	3943.8	8.8	Pt.
005475 U Tucanae—						
	3854.9	10.3	Bl.	3875.9	12.0	Bl.
	3867.9	11.4	Bl.	3903.9	13.2	Bl.
011041 UZ Andromedae—						
	3944.8	15.0	Wf.			
013238 RU Andromedae—						
	3944.8	11.2	Wf.			
014958 X Cassiopeiae—						
	3899.6	12.4	Pt.			
015354 U Persei—						
	3899.6	9.4	Pt.	3940.8	9.0	Ca.
	3911.8	9.9	Ca.			
021024 R Arietis—						
	3953.8	8.3	Ca.			
021258 T Persei—						
	3881.1	8.8	Ch.	3899.6	8.5	Pt.
021403 *o* Ceti—						
	3807.9	4.8	Mt.	3839.9	4.4	Mt.
	3810.9	4.9	Mt.	3840.9	4.3	Mt.
	3816.9	4.6	Mt.	3842.0	4.4	Mt.
	3836.0	4.3	Mt.	3848.9	4.9	Mt.
	3837.0	4.3	Mt.	3853.0	5.3	Mt.
	3837.9	4.3	Mt.			
021558 S Persei—						
	3881.1	8.6	Ch.	3899.6	8.3	Pt.
022150 RR Persei—						
	3899.6	8.6	Pt.	3926.7	9.2	Wf.
	3899.7	8.6	Wf.	3944.8	10.2	Wf.
	3911.7	8.7	Wf.			
022426 R Fornacis—						
	3854.9	11.8	Bl.	3875.9	12.4	Bl.
	3867.9	12.1	Bl.			
022980 RR Cephei—						
	3907.8	14.0	Pa.	3935.7	13.7	Wf.
	3911.7	14.6	Wf.	3944.7	13.9	Wf.
	3926.7	14.2	Wf.			
023133 R Trianguli—						
	3874.9	5.8	Kd.	3878.9	5.8	Kd.
024356 W Persei—						
	3811.2	10.0	Nk.	3898.0	10.0	Nk.
	3832.0	10.0	Mj.	3899.6	9.6	Pt.
	3842.0	10.5	Mj.	3903.6	10.4	Cy.
	3846.0	10.5	Mj.	3904.0	10.0	Nk.
	3866.0	10.0	Nk.	3911.8	10.0	Ca.
	3895.5	10.0	Cy.	3940.8	10.0	Ca.
025050 R Horologii—						
	3854.9	12.7	Bl.	3875.9	13.2	Bl.
	3867.9	13.0	Bl.	3903.9	13.4	Bl.
025751 T Horologii—						
	3854.9	12.6	Bl.	3885.0	10.6	Bl.
	3867.9	11.4	Bl.	3903.9	9.4	Bl.
	3875.9	11.0	Bl.			
032043 Y Persei—						
	3899.6	10.2	Pt.			
032335 R Persei—						
	3899.6	10.9	Pt.			
032443 Nova Persei 22—						
	3811.1	14.6	Nk.			
042209 R Tauri—						
	3911.6	9.1	Kl.			
042215 W Tauri—						
	3842.0	8.9	Nk.	3899.6	11.0	Pt.
	3846.0	8.9	Nk.			
043065 T Camelopardalis—						
	3899.6	9.0	Pt.	3928.6	8.5	Pt.
043208 RX Tauri—						
	3898.5	9.4	B.			
043263 R Reticulae—						
	3854.9	7.5	Bl.	3885.0	8.1	Pt.
	3867.9	7.5	Bl.	3903.9	9.0	Bl.
	3875.9	7.8	Bl.			
043274 X Camelopardalis—						
	3899.6	12.4	Pt.	3928.6	9.0	Pt.
	3902.6	12.0	B.			
043738 R Caeli—						
	3854.9	7.8	Bl.	3885.0	8.6	Bl.
	3867.9	8.2	Bl.	3903.9	8.8	Bl.
	3875.9	8.5	Bl.			
044349 R Pictoris—						
	3854.9	7.3	Bl.	3885.0	7.2	Bl.
	3867.9	6.7	Bl.	3903.9	7.6	Bl.
	3875.9	6.7	Bl.			

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
044617 V TAURI—				
	3899.6	9.6 Pt,	3902.5	9.7 B.
045514 R LEPORIS—				
	3880.1	9.6 Ch.		
050003 V ORIONIS—				
	3880.1	10.0 Ch,	3898.5	9.7 B.
050022 T LEPORIS—				
	3854.9	9.4 Bl,	3885.0	10.2 Bl,
	3867.9	9.0 Bl,	3903.9	10.8 Bl.
	3875.9	10.3 Bl,		
050848 S PICTORIS—				
	3855.0	9.7 Bl,	3885.0	10.1 Bl,
	3867.9	10.2 Bl,	3903.9	10.7 Bl.
	3875.9	10.2 Bl,		
050953 R AURIGAE—				
	3894.6	8.7 Lv.	3910.6	9.2 Ie,
	3898.6	9.8 B,	3911.7	9.2 Ca,
	3899.6	8.5 Pt,	3928.6	9.6 Pt.
	3901.6	8.8 Ca,		
051247 T PICTORIS—				
	3855.0	8.9 Bl,	3885.0	10.7 Bl,
	3867.9	9.3 Bl,	3903.9	11.5 Bl.
	3875.9	10.1 Bl,		
051533 T COLUMBAE—				
	3855.0	8.9 Bl,	3885.0	7.5 Bl,
	3867.9	8.5 Bl,	3903.9	7.3 B'
	3875.9	8.2 Bl,		
052034 S AURIGAE—				
	3899.6	9.0 Pt,	3905.6	9.4 B,
	3904.7	9.8 Kl,	3907.7	10.2 Sg.
052036 W AURIGAE—				
	3899.6	13.8 Pt.		
053005a T ORIONIS—				
	3866.0	11.1 Nk,	3899.6	10.5 Pt,
	3895.6	10.8 B.	3902.5	10.8 B.
	3898.0	11.0 Nk,		
053068 S CAMELOPARDALIS—				
	3928.6	9.1 Pt.		
053326 RR TAURI—				
	3902.6	12.9 B.		
053337 RU AURIGAE—				
	3899.6	10.0 Pt,	3907.7	9.8 Sg.
053531 U AURIGAE—				
	3899.6	13.2 Pt,	3904.6	13.1 B.
054319 SU TAURI—				
	3880.1	9.8 Ch,	3904.6	9.5 B,
	3894.6	9.5 Lv,	3905.6	9.8 Pt,
	3896.7	9.4 Br,	3905.6	9.4 Wf,
	3899.6	9.6 Pt,	3906.7	9.5 Wf,
	3900.1	9.7 Ch,	3907.6	9.8 Pt,
	3900.6	9.4 Wf,	3908.6	9.7 Pt,
	3900.6	9.6 Pt,	3910.6	9.8 Pt.
	3900.7	9.5 Br,	3911.7	9.4 Wf,
	3901.7	9.5 Br,	1918.7	9.7 Pt.
	3902.7	9.4 Wf,		
054331 S COLUMBAE—				
	3855.0	13.0 Bl,	3885.0	11.7 Bl,
	3867.9	12.7 Bl,	3903.9	9.8 Bl.
	3875.9	11.9 Bl,		

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
054920a U ORIONIS—				
	3866.0	11.3 Nk,	3899.6	11.4 Cy,
	3871.6	10.0 Gb,	3902.6	10.2 B,
	3894.6	10.8 Lv,	3904.0	10.9 Nk,
	3898.0	11.1 Nk,	3906.0	10.8 Nk,
	3899.6	11.4 Pt,	3908.6	10.7 Ca,
054920b UW ORIONIS—				
	3894.6	10.8 Lv,	3903.6	10.5 Cy.
	3899.6	10.5 Cy,		
054974 V CAMELOPARDALIS—				
	3907.8	15.5 Pa.		
055353 Z AURIGAE—				
	3832.0	9.7 Mj,	3917.7	10.1 Wf,
	3842.0	10.7 Mj,	3919.6	10.2 B,
	3846.0	10.7 Mj,	3926.7	9.9 Wf,
	3898.6	9.5 B,	3928.6	10.0 Pt,
	3899.6	10.0 Pt,	3931.7	9.7 Wf,
	3899.8	10.1 Wf,	3935.7	9.7 Wf,
	3811.7	9.9 Wf,	3944.7	10.0 Wf.
055686 R OCTANTIS—				
	3855.0	11.0 Bl,	3885.0	11.2 Bl,
	3867.9	11.1 Bl,	3903.9	11.7 Bl.
	3875.9	11.2 Bl,		
060450 X AURIGAE—				
	3896.6	10.1 Ro,	3910.6	8.6 Ie,
	3899.6	10.0 Ro,	3928.6	8.1 Pt.
	3905.6	9.1 B,		
060547 SS AURIGAE—				
	3840.5	[12.6 Kl,	3907.6	[11.2 Hr,
	3847.6	10.5 Kl,	3907.7	[13.3 Br,
	3849.7	11.0 Kl,	3908.6	[12.6 Pt,
	3860.6	[11.8 Kl,	3909.6	[11.6 Kl,
	3877.2	[11.1 Ch,	3910.1	[11.1 Ch,
	3880.1	[11.1 Ch,	3910.5	[12.6 Ie,
	3881.1	[11.1 Ch,	3910.6	[11.6 Cy,
	3884.2	[11.1 Ch,	3910.6	[12.6 Pt,
	3885.1	[11.1 Ch,	3910.6	[11.4 O.
	3886.1	[11.1 Ch,	3911.6	[13.3 Cd,
	3888.2	[10.5 Ch,	3911.6	[11.8 Kl,
	3889.2	[10.8 Ch,	3911.6	[12.6 Pt,
	3895.6	[13.3 Lv,	3911.7	14.9 Wf,
	3895.6	[11.3 Cv.	3912.6	[12.4 Pt,
	3896.7	[13.3 Br,	3912.7	[12.4 Sg,
	3896.8	[12.6 Sg,	3913.7	14.8 Wf,
	3898.5	[12.4 Ie,	3914.7	[14.5 Wf,
	3898.5	[11.6 Cy,	3915.7	[14.5 Wf,
	3898.7	[13.3 Lv,	3916.7	[13.5 Wf,
	3899.6	[12.6 Pt,	3917.6	[12.6 Cd,
	3899.6	[12.4 Kl,	3917.6	[11.5 Kl,
	3899.6	[11.6 Cy,	3917.7	[13.5 Wf,
	3899.7	14.9 Wf,	3918.7	[12 4 Pt,
	3899.7	[13.7 Sg,	3918.7	[13.5 Wf,
	3900.1	[11.6 Ch,	3919.7	[11.0 Pt,
	3900.6	[12.6 Pt,	3921.6	[10.5 Cy,
	3900.7	14.8 Wf,	3921.8	[13.0 Wf,
	3900.7	[13.1 Br,	3922.7	[12.0 Pt,
	3901.6	[12.4 Ca,	3926.7	[14.5 Wf,
	3901.7	[13.3 Br,	3927.6	[12.6 Pt,
	3902.6	[11.6 Cy	3928.6	[12.4 Ca,
	3902.6	[13.3 Y,	3928.6	[12 4 Pt,

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
060547 SS AURIGAE—Continued.						
	3902.7	14.8	Wf,	3929.7	[13.5	Wf,
	3903.6	[11.6	Cy,	3931.7	[13.3	Wf,
	3904.6	[13.3	B,	3931.7	[12.4	Pt,
	3904.6	[12.6	Kl,	3934.7	[12.4	Wf,
	3905.6	[12.6	Pt,	3934.7	[12.6	Pt,
	3905.7	14.7	Wf,	3935.6	[12.4	Ca,
	3906.7	[14.9	Sg.	3935.7	[11.0	Wf,
	3906.7	14.9	Wf,	3935.7	[11.0	Pt,
	3906.7	[13.3	Br,	3936.6	[11.5	Pt.
	3907.1	[10.8	Ch,	3938.7	[13.5	Wf,
	3907.6	[13.3	Y,	3939.7	[12.4	Wf,
	3907.6	[11.2	Cy,	3943.6	[11.0	Pt.
	3907.6	[13.7	Lv,	3944.7	[12.4	Wf.
	3907.6	[12.6	Pt,			
061647 V AURIGAE—						
	3897.6	10.6	B.			
061702 V MONOCEROTIS—						
	3881.1	7.4	Ch,	3899.6	7.8	Pt.
061907 T MONOCEROTIS—						
	3846.3	5.9	Sl,	3856.3	6.7	Sl,
	3847.3	6.1	Sl,	3857.3	6.8	Sl,
	3849.3	6.2	Sl,	3858.3	6.9	Sl,
	3852.3	6.1	Sl,	3871.3	5.8	Sl,
	3854.3	6.3	Sl,	3875.3	6.1	Sl,
	3855.3	6.6	Sl,	3881.3	6.3	Sl.
063159 U LYNCIS—						
	3902.6	13.4	B,	3907.6	12.6	Y.
063308 R MONOCEROTIS—						
	3899.6	11.1	Pt.			
063558 S LYNCIS—						
	3881.1	10.2	Ch.	3899.6	10.0	Pt,
	3898.6	10.3	B,	3928.6	11.7	Pt.
064030 X GEMINORUM—						
	3901.6	11.1	B.			
064707 W MONOCEROTIS—						
	3898.6	10.7	B,	3899.6	11.2	Pt.
065208 X MONOCEROTIS—						
	3858.0	9.4	Mt,	3884.0	8.8	Mt,
	3861.0	9.2	Mt,	3894.0	8.3	Mt,
	3862.0	9.2	Mt,	3897.0	8.2	Mt,
	3863.0	9.1	Mt,	3898 0	8.2	Mt,
	3865.0	9.2	Mt,	3902.0	8.2	Mt,
	3866.0	9.2	Mt,	3903.0	8.2	Mt,
	3877.2	8.2	Ch,	3904.0	8.2	Mt,
	3880.0	9.1	Mt,	3905.0	8.2	Mt.
	3883.0	8.5	Mt,			
065355 R LYNCIS—						
	3907.6	8.8	Y,	3919.6	8.6	Ie.
070122a R GEMINORUM—						
	3898.6	11.5	Kl,	3910.6	12.2	Ie,
	3899.6	12.1	Pt,	3911.6	11.5	Kl,
	3904.6	12.0	B,	3928.6	13.4	Pt.
	3908.6	11.8	Ca,			
070122b Z GEMINORUM—						
	3898.6	12.6	Lv,	3910.6	12.4	Ie,
	3899.6	12.4	Pt,	3928.6	12.4	Pt.
	3904.6	12.6	B,			
070122c TW GEMINORUM—						
	3898.6	8.1	Lv.	3908.6	8.2	Ca,
	3899.6	7.8	Pt,	3928.6	7.9	Pt.
	3904.6	8.3	B,			
070310 R CANIS MINORIS—						
	3895.6	9.4	B.	3905.6	9.4	B.
071713 V GEMINORUM—						
	3902.6	13.6	B.			
072708 S CANIS MINORIS—						
	3866.0	7.5	Nk,	3906.0	7.3	Nk,
	3883.2	7.6	Ch,	3907.6	7.8	Cy,
	3895.6	7.3	B,	3907.6	7.3	Hr,
	3895.6	7.4	Cy,	3908.6	7.4	Ca,
	3895.7	7.3	Js,	3910.5	7.5	Ya,
	3898.0	7.3	Nk,	3910.6	7.7	O,
	3899.6	7.1	Pt,	3910.6	7.5	Ie,
	3901.5	7.3	Ca,	3910.6	8.3	M.
	3902.6	7.7	O,	3911.5	7.4	Cd,
	3903.6	7.6	Cy,	3925.6	8.3	Ca,
	3905.6	7.5	B,	3928.6	7.8	Pt.
073173 S VOLANTIS—						
	3855.0	11.6	Bl,	3875.9	12.0	Bl,
	3867.9	11.8	Bl,	3903.9	13.0	Bl.
073508 U CANIS MINORIS—						
	3895.6	9.4	B,	3902.6	9.5	Y,
	3899.6	9.5	Pt,	3928.6	10.2	Pt.
073723 S GEMINORUM—						
	3896.6	9.3	M,	3901.6	12.8	B,
	3899.6	12.4	Pt,	3928.6	9.5	Pt.
074241 W PUPPIS—						
	3855.0	9.7	Bl,	3885.0	8.2	Bl.
	3867.9	8.3	Bl,	3903.9	8.9	Bl.
	3876.0	8.2	Bl,			
074323 T GEMINORUM—						
	3896.6	10.4	M,	3918.6	9.4	B,
	3901.6	10.3	B,	3937.6	8.8	B.
074922 U GEMINORUM—						
	3840.5	[13.0	Kl,	3906.7	14.0	Wf,
	3847.5	[13.0	Kl,	3906.7	[13.3	Br,
	3849.5	[12.6	Kl,	3907.1	[11.4	Ch,
	3866.1	[13.7	Nk,	3907.6	[10.9	Cy,
	3877.2	[11.7	Ch,	3907.6	[13.7	Y,
	3878.2	[11.4	Ch,	3907.6	[13.3	Pt,
	3879.1	[11.4	Ch,	3907.6	[13.8	Lv,
	3880.1	[11.4	Ch,	3907.7	[13.3	Br,
	3881.1	[11.4	Ch,	3908.6	13.9	B,
	3882.1	[11.4	Ch,	3908.6	[12.4	Pt,
	3883.2	[11.4	Ch,	3909.6	[12.3	Kl,
	3884.2	[12.3	Ch,	3910.1	[11.4	Ch,
	3885.2	[11.7	Ch,	3910.6	[13.3	Pt,
	3886.2	[11.4	Ch.	3910.6	[11.7	Cy,
	3887.2	[10.1	Ch,	3910.6	[12.4	O,
	3890.1	[10.1	Ch,	3910.6	[12.6	Ie,
	3891.2	[10.1	Ch,	3991.1	[11.7	Ch,
	3892.1	[10.1	Ch,	3911.6	13.7	Cd,
	3893.7	[13.4	Lv,	3911.6	[12.4	Kl.
	3895.6	[11.4	Cy,	3911.7	13.8	Wf,
	3895.6	[13.3	B.	3911.7	[13.3	Pt,
	3896.7	[13.3	Br,	3912.1	[10.2	Ch,

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
074922 U GEMINORUM—Continued.						
	3897.2	[10.2	Ch,	3912.6	[13.7	Ch,
	3898.0	14.0	Nk,	3912.6	[12.4	Pt,
	3898.6	[13.3	Ie,	3913.6	[12.4	M,
	3898.6	[13.7	Lv,	3913.7	[14.1	Wf,
	3898.6	[11.4	Cy,	3914.7	[13.7	Wf,
	3899.1	[11.4	Ch,	3915.7	[13.3	Wf,
	3899.6	[12.4	Kl,	3916.7	[13.3	Wf,
	3899.6	[13.3	Pt,	3917.6	[12.5	B,
	3899.6	[11.7	Cy,	3917.7	[13.3	Wf,
	3899.7	14.0	Wf,	3918.7	[10.1	Pt,
	3900.1	[12.3	Ch,	3918.7	[13.3	Wf,
	3900.6	[12.4	Pt,	3919.7	[10.1	Pt,
	3900.6	[13.7	B,	3921.7	[12.4	Wf,
	3900.7	13.9	Wf,	3922.7	[10.0	Pt,
	3900.7	[13.3	Br,	3924.6	[10.0	Pt,
	3901.5	[12.4	Ca,	3925.6	[11.0	Ca,
	3901.6	14.0	B,	3926.7	13.7	Wf,
	3901.7	[13.3	Br,	3927.6	[13.3	Pt,
	3902.1	[11.4	Ch,	3928.6	[12.4	Pt,
	3902.6	[12.4	Y,	3928.6	[12.3	Ca,
	3902.6	[11.7	Cy,	3929.7	[13.3	Wf,
	3902.7	13.9	Wf	3931.7	[13.3	Wf,
	3903.2	[11.4	Ch,	3931.7	[11.0	Pt,
	3903.6	[12.3	Cy,	3932.6	[13.5	B,
	3904.0	13.9	Nk,	3934.7	[12.0	Pt,
	3904.6	[13.8	Ch,	3935.6	[12.3	Ca,
	3904.6	[12.3	Kl,	3935.7	[10.3	Wf,
	3905.6	[13.3	Pt,	3936.6	[10.1	Pt,
	3905.7	13.7	Wf,	3943.6	[10.0	Pt.
	3906.0	13.9	Nk,			
075612 U PUPPIS—						
	3902.6	9.5	Ya,	3904.6	9.4	B,
	3902.6	10.1	Y,	3908.6	9.5	B.
081112 R CANCRI—						
	3879.2	6.6	Ch,	3907.6	7.6	Cy,
	3890.2	7.0	Ch,	3908.6	7.2	Ly,
	3899.6	6.8	Ly,	3908.6	7.4	Ca,
	3999.6	7.1	Pt,	3909.6	7.4	Kl,
	3901.6	6.9	Ca,	3910.2	7.6	Ch,
	3902.6	7.7	Ya,	3910.6	7.3	Ie,
	3903.6	7.3	Cy,	3910.6	8.7	O,
	3904.6	7.2	Ly,	3928.6	7.9	Pt,
	3905.6	7.2	B,	3928.6	8.5	Ca,
	3907.6	7.6	Hr,	3935.6	8.4	B.
081617 V CANCRI—						
	3884.2	8.0	Ch,	3907.6	8.4	Cy,
	3895.6	8.1	B,	3907.6	8.5	Hr,
	3898.0	8.0	Nk,	3910.6	8.5	O,
	3899.6	7.6	Pt,	3914.6	8.2	B.
	3902.6	7.8	Ya,	3928.6	8.4	Pt.
	3902.6	8.4	Cy,			
082405 RT HYDRAE—						
	3899.6	7.1	Pt,	3919.6	7.6	B,
	3904.6	7.5	B,	3937.6	8.0	B.
082476 R CHAMAELEONTIS—						
	3903.9	12.4	Bl.			
083019 U CANCRI—						
	3893.7	11.2	Lv,	3910.6	11.6	Ie,
	3899.8	11.1	Wf,	3911.7	11.7	Wf,
	3901.6	11.2	B,	3919.6	12.1	B,
	3907.6	11.8	Lv,	3929.7	12.6	Wf.
084803 S HYDRAE—						
	3879.2	9.9	Ch,	3910.2	8.5	Ch,
	3897.2	9.0	Ch,	3913.6	8.0	M,
	3898.6	9.1	B,	3914.6	8.0	B,
	3899.6	8.7	Pt,	3928.6	7.8	Pt,
	3902.2	8.7	Ch,	3930.6	7.9	B.
	3902.6	8.6	Ya,			
085068 T HYDRAE—						
	3898.6	12.4	B,	3914.6	12.8	B.
	3899.6	12.5	Pt,			
085120 T CANCRI—						
	3866.0	9.4	Nk,	3906.0	9.5	Nk,
	3884.2	9.7	Ch,	3928.6	8.3	Pt.
	3899.6	8.2	Pt,			
090024 S PYXIDIS—						
	3900.6	13.0	Pt.			
090151 V URSAE MAJORIS—						
	3898.0	10.4	Nk,	3918.6	10.4	B,
	3900.6	10.3	B,	3936.6	10.4	B.
090425 W CANCRI—						
	3898.0	11.0	Nk,	3911.7	11.0	Wf,
	3899.7	10.6	Cy,	3919.6	10.8	B,
	3899.8	10.7	Wf,	3929.7	11.5	Wf,
	3907.6	11.0	Cy,	3936.6	11.8	B.
	3907.6	11.0	Hr,			
091868 RW CARINAE—						
	3876.0	12.6	Bl,	3903.9	11.5	Bl.
	3885.0	11.8	Bl,			
092551 Y VELORUM—						
	3855.0	13.5	Bl,	3885.0	12.8	Bl,
	3876.0	14.0	Bl,	3903.9	12.9	Bl.
092962 R CARINAE—						
	3855.0	6.0	Bl,	3885.0	7.8	Bl,
	3867.9	6.8	Bl,	3903.9	8.8	Bl.
	3876.0	7.4	Bl,			
093014 X HYDRAE—						
	3884.2	10.6	Ch,	3910.2	9.4	Ch,
	3899.6	9.5	Ya,	3919.6	8.6	B,
	3900.1	9.5	Ch,	3928.6	8.7	Pt,
	3900.6	9.6	Pt,	3932.6	8.3	Pt.
	3900.6	9.0	B,			
093178 Y DRACONIS—						
	3907.6	12.8	Y,	3937.6	9.1	B.
093934 R LEONIS MINORIS—						
	3879.2	7.0	Ch,	3907.8	8.0	Cy,
	3887.2	7.2	Ch,	3910.2	7.8	Ch,
	3899.6	7.9	Cy,	3910.6	7.8	Al,
	3900.6	7.5	Pt,	3910.6	8.4	M,
	3902.2	7.6	Ch,	3911.8	7.7	Kl,
	3902.6	7.8	Ya,	3912.6	8.2	B,
	3902.6	7.5	Al,	3928.7	8.5	Pt,
	3907.8	7.8	Hr,	3930.6	8.8	B.

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
094211 R LEONIS—				
	3879.2	9.0 Ch,	3911.2	8.8 Ch,
	3887.2	8 9 Ch,	3911.6	8.5 Ro,
	3895.6	8.9 Cy,	3911.7	8.7 Js,
	3896.6	8.9 Ro,	3911.7	7.4 Ca,
	3898.0	8.9 Nk,	3914.6	7.1 Ro,
	3899.6	8.8 Ro,	3921.6	7.0 Cy,
	3899.6	9.0 Ly,	3922 6	6 6 Ro,
	3899.6	8.8 Ya,	3924.5	6.6 Ro,
	3899.7	9.0 Js,	3925.6	6.6 Ca,
	3900.6	8.1 Pt,	3928.5	6.4 Ro,
	3901.6	8.0 Ca,	3928.6	6.5 Ca,
	3902 2	8 9 Ch,	3928.7	6.4 Pt,
	3902.6	8.6 Al,	3931.5	6.0 Ro,
	3904.6	8.8 Ly,	3931.6	6.1 Al,
	3905.6	8.2 B,	3931.6	6.9 O,
	3907.6	8.2 Hr,	3935.6	6.3 B,
	3907.6	8.6 Al,	3939.6	6.1 Mi,
	3907.6	8.4 Cy,	3940.5	5.6 Ca,
	3908.6	8.7 Ly,	3944.6	6.2 O,
	3910.6	8.6 M,	3944.6	6.4 Mi,
	3910 6	7.8 Al,	3946.6	5.5 Ca,
	3910.6	8.6 Ro,	3953.6	5.6 Ca.
	3910.7	8.0 Sg,		
094622 Y HYDRAE—				
	3900.6	6.2 Pt,	3928.7	6.2 Pt.
094953 Z VELORUM—				
	3876.0	13.8 Bl.		
095421 V LEONIS—				
	3893.7	10.7 Lv,	3907.7	12.0 Lv,
	3895 6	10.5 Cy,	3911.7	12.3 Wf,
	3898.7	11.1 Lv,	3918.6	12.0 B,
	3899.8	11.0 Sy,	3927.7	12.7 Wf,
	3899.8	10.9 Wf,	3928.7	12.4 Pt,
	3900 6	11.4 Pt,	3936.6	12.7 B,
	3907.6	10.8 Cy,	3939.7	13.0 Wf.
	3907.6	11.0 Hr,		
095563 RV CARINAE—				
	3876.0	10.8 Bl,	3903.9	11.1 Bl.
	3885.1	10.3 Bl,		
100661 S CARINAE—				
	3855.0	5.3 Bl,	3885.1	5.8 Bl,
	3868.0	5.3 Bl,	3903.9	7.3 Bl.
	3876.0	6.0 Bl,		
101153 W VELORUM—				
	3876.0	13.5 Bl.	3904.0	13.0 Bl.
103212 U HYDRAE—				
	3878.9	6.1 Kd,	3897.9	6.2 Kd,
	3886.1	5.8 Ks,	3902.0	5.8 Ks,
	3897.0	5.9 Ks,	3905.0	5.9 Ks.
103769 R URSAE MAJORIS—				
	3879.2	6.9 Ch,	3910.2	8.3 Ch,
	3885.1	7.0 Ch,	3910.6	8.5 Ya,
	3893.7	7.7 Lv,	3911.6	8.1 Ro,
	3895.6	8.1 Cy,	3912.6	8.6 Ie,
	3896 6	6.5 M,	3914 6	8.3 Ro,
	3897.1	7.4 Ch,	3917.6	8.7 Cd,
	3899.6	7.8 Kl,	3919.8	8.8 Cy,
	3900.6	7.7 Pt,	3921.6	9.3 Ly,
	3901.6	7.9 B,	3921.7	9.3 Lv,
103769 R URSAE MAJORIS—Continued.				
	3901.6	7 9 Ca,	3923.7	9.0 Hr,
	3902 6	8.2 Ly,	3924.5	8.6 Ro,
	3902.6	7.8 Al,	3925.7	9.2 Ca,
	3907.6	8.0 Al,	3928.5	8.8 Ro,
	3907.7	8.2 Sg,	3928.7	9.1 Pt,
	3907.8	8.4 Cy,	3935.7	9.6 Ca,
	3908.6	8.4 Ly,	3937.6	9.1 B,
	3908.8	8.3 Ca,	3951.7	10.1 Ca.
	3909.6	8.5 Lv,		
104620 V HYDRAE—				
	3855.0	9.0 Bl,	3900.6	9.2 Pt,
	3868.0	9.2 Bl,	3904 0	9.7 Bl,
	3876 0	9.0 Bl,	3907.2	10.8 Ch,
	3884.2	10.2 Ch,	3910.2	10.7 Ch,
	3885.1	9.4 Bl,	3911.1	10.8 Ch,
	3899.6	10 4 Ya,	3928.7	10.8 Pt,
	3900.1	10.5 Ch,		
104628 RS HYDRAE—				
	3875.9	14.2 Bl,	3904.0	13.1 Bl.
104814 W LEONIS—				
	3898.6	11.2 Lv,	3907.7	11.5 Lv,
	3899.7	10.9 Cy,	3910.6	11.3 M,
	3900.6	10.8 Pt,	3928.7	11 9 Pt,
	3902.6	10.7 Y,	3932.6	12.2 B,
	3907.6	11.2 Cy,	3936.6	12.2 B,
	3907.6	11.3 Hr,	3944.6	12.2 B.
110506 S LEONIS—				
	3900.6	11.4 Pt,	3932.6	12 8 B,
	3910.6	11.9 Ie,	3944.6	13.4 B.
	3928.7	13.0 Pt,		
111661 RS CARINAE—				
	3855.0	10.1 Bl,	3885.1	9.2 Bl,
	3868.0	9.3 Bl,	3905.9	9.1 Bl.
	3876.0	9.4 Bl,		
114441 X CENTAURI—				
	3876.0	13.8 Bl.		
115058 W CENTAURI—				
	3855.0	8.1 Bl,	3885.1	9.2 Bl,
	3868.0	8.5 Bl,	3905.9	11.3 Bl.
	3876.0	8.8 Bl,		
115919 R COMAE BERENICES—				
	3898.6	10.7 Lv,	3911.7	9.0 Wf,
	3899.7	10.5 Wf,	3912.7	8.8 Ca,
	3902.7	10.4 Ca,	3913.6	8.4 B,
	3904.6	9 8 Kl,	3928.7	8.3 Pt,
	3907.7	9.3 Lv,	3935.6	7.6 Ca,
	3907.7	9.2 Sg,	3950.6	8.6 B,
	3910.6	8.4 Ie,	3955.6	8.6 Ca.
	3910.6	9.5 Ya,		
120012 SU VIRGINIS—				
	3900.6	11.7 Pt,	3928.7	9.3 Pt,
	3901.6	11.5 B,	3936.6	9.8 B.
120905 T VIRGINIS—				
	3898.6	12.2 Lv,	3907.7	11.3 Lv,
	3900.6	12.4 Pt,	3918 6	10.0 B,
	3901.6	11.7 B,	3928.7	9.8 Pt,
	3907.8	11.3 Pa,	3944.6	9.1 B.

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
121418 R CORVI—				
	3898.6	12.2 B,	3928.7	13.8 Pt,
	3900.6	12.5 Pt,	3934.6	13.1 B.
	3914.6	12.9 B,		
122001 SS VIRGINIS—				
	3912.6	8.6 B,	3944.6	8.0 B.
122532 T CANUM VENATICORUM—				
	3900.6	9.6 B,	3910.6	10.0 Ya,
	3900.6	9.4 Pt,	3928.7	9.8 Pt.
	3900.8	9.6 M,		
122803 Y VIRGINIS—				
	3901.7	13.0 Br,	3934.6	10.7 B.
	3902.6	12.6 B,		
122854 U CENTAURI—				
	3855.0	8.8 Bl,	3885.1	8.4 Bl,
	3868.0	8.6 Bl,	3906.0	8.7 Bl.
	3876.0	8.5 Bl,		
123160 T URSAE MAJORIS—				
	3893.6	9.4 B,	3907.8	10.6 Cy,
	3895.6	9.3 Cy,	3908.6	10.0 B,
	3896.6	9.8 Ro,	3908.6	9.9 Ly,
	3896.7	9.5 Sg,	3908.8	10 3 Ca,
	3899.6	9.7 Ro,	3909.7	10.0 Ro,
	3899.6	9.7 Kl,	3910.6	10.1 Ya,
	3900.6	9.7 B,	3910.6	10.8 Al,
	3900.6	9.7 Pt,	3919.7	11.0 Sg,
	3901.6	9.9 Ca,	3928.7	11.4 Pt,
	3903.6	10.0 M,	3931.5	11.9 Ro,
	3902.6	9.8 Ly,	3935.7	12.0 Ca.
	3907.7	10.0 Sg.		
123307 R VIRGINIS—				
	3900.6	9.5 Pt,	3931.6	7.5 Ca,
	3901.6	9.5 Ca,	3933.7	6 8 Pt,
	3911.7	8.7 Ca,	3942.6	6.8 Ca,
	3913.6	8.0 B,	3944.6	6.8 B,
	3925.6	7.7 Ca,	3953.6	6.9 Ca.
123459 RS URSAE MAJORIS—				
	3899.7	13.6 Sg,	3935.7	11.8 Wf,
	3900.6	13.0 Pt,	3941.7	10.8 Mi,
	3900.7	13.9 Wf,	3943.7	10.8 Mi,
	3901.7	13.5 Br,	3944.6	10.8 Mi,
	3903.6	13.0 M,	3944.7	11.0 Wf,
	3908.6	13.3 B,	3928.7	12.6 Pt,
	3911.7	13.0 Wf,	3929.7	12.2 Wf.
123961 S URSAE MAJORIS—				
	3895.6	10.0 Cy,	3908.8	10.5 Ca,
	3896.7	10.5 Sg,	3909.7	10.9 Ro,
	3896.7	10.6 Ro,	3910.6	10.9 Ya,
	3899.6	10.4 Kl,	3910.6	11.0 Al,
	3899.6	10.6 Ro,	3919.7	11.2 Sg,
	3900.6	10.0 Pt,	3928.7	11.2 Pt,
	3900.6	10.2 B,	3931.5	11.5 Ro,
	3902.6	10.3 Ly,	3935.7	11.5 Ca,
	3903.6	10.7 M,	3941.7	11.1 Mi,
	3907.7	10.6 Sg,	3944.5	11.0 Ro,
	3907 8	10.8 Cy,	3944.6	11.4 Mi,
	3908.6	10.4 Ly,	3950.6	10.5 B.
124204 RU VIRGINIS—				
	3900.6	12.3 Pt,	3934.6	12.2 B,
	3900.7	12.4 Br,	3934.7	12.6 Pt.
	3901.6	12.2 B,		
124606 U VIRGINIS—				
	3900.6	8.4 Pt,	3912.6	9.2 B,
	3900.7	8.5 Br,	3926.6	9.8 B,
	3901.6	8.8 B,	3934.7	9.1 Pt,
	3902.7	8.8 Cy,	3944.6	10.7 B.
	3910.8	9.1 Cy,		
130212 RV VIRGINIS—				
	3898.0	13.7 Nk,	3911.7	14.3 Wf,
	3899.8	13.8 Wf,	3929.7	14.5 Wf.
	3908.6	13.7 B,		
131283 U OCTANTIS—				
	3876.0	13.6 Bl.	3906.0	12.7 Bl.
132202 V VIRGINIS—				
	3908.6	13.7 B,	3934.6	11.8 B.
132122 R HYDRAE—				
	3855.0	4.1 Bl,	3898 1	4.8 Kd,
	3868.0	4.0 Bl.	3900.2	5 0 Ch,
	3876.0	4.1 Bl.	3900.6	5.2 Pt,
	3877.1	4.4 Kd,	3906.0	4.8 Bl.
	3879.2	4.2 Ch,	3910.1	5.3 Ch,
	3885.2	4 3 Ch,	3911.7	5.3 Ca,
	3886.1	4.3 Kd,	3934.7	6.0 Pt.
	3890.2	4.5 Ch,		
132706 S VIRGINIS—				
	3886.1	7.2 Ks,	3907.8	7.7 Cy,
	3890.2	7.0 Ch,	3911.7	7.4 Ca,
	3897.0	7.2 Ks,	3913.6	8 0 M,
	3898.7	7.2 B,	3914.6	7.9 B,
	3899.8	6 9 Cy	3925.6	7.8 Ca,
	3900.6	6.8 Pt,	3928.6	7.8 Ca,
	3901.6	7.2 Ca,	3934.7	8.0 Pt,
	3901.7	7.5 Br,	3942.6	8.5 Ca.
	3902.0	7.4 Ks,	3944.6	8.3 B,
	3904.7	7.1 Kl.	3955.6	8.8 Ca,
	3905.0	7.4 Ks,	3979.7	8.0 Al.
	3907.7	7.0 Sg,		
133155 RV CENTAURI—				
	3855.0	8.9 Bl,	3876.0	9.0 Bl,
	3868.0	8.9 Bl,	3885.1	8.7 Bl.
133273 T URSAE MINORIS—				
	3900.7	9.0 Wf,	3929.7	10.7 Wf,
	3910.6	9.5 M,	3939.7	11.1 Wf.
	3913.7	8.8 Wf,		
133633 T CENTAURI—				
	3855.0	6.2 Bl,	3876.0	5.8 Bl.
	3868 0	5.6 Bl,	3906.0	7.2 Bl.
134236 RT CENTAURI—				
	3855.0	11.7 Bl,	3876.0	10.7 Bl,
	3868.0	11.0 Bl.	3906.0	9.2 Bl.
134440 R CANUM VENATICORUM—				
	3899.6	9.2 Ly,	3904.6	9.2 Ly,
	3899.8	9.4 Cy,	3907.8	9.6 Cy,
	3900.6	9.3 Pt,	3910.6	9.4 Ly,
	3900.8	9.1 M,	3919.6	10.3 Ie,
	3901.5	9.3 B,	3926.6	10.3 B,
	3904.6	10.2 Kl,	3934.7	10.4 Pt.

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
134677 T APODIS—						
	3855.0	10.3	Bl,	3885.1	10.1	Bl,
	3868 0	10.3	Bl,	3906.0	10.4	Bl.
	3876.0	10.2	Bl,			
135908 RR VIRGINIS—						
	3900.8	14.9	Pa,	3934.7	13.9	B.
	3907.8	15.1	Pa.			
140113 Z BOOTIS—						
	3900.7	12.8	Wf,	3911.8	11.4	Wf,
	3901.7	13.0	B,	3928.7	9.8	Wf,
	3903.6	13.0	M,	3939.7	9.7	Wf.
	3907.7	12.3	Br,			
140512 Z VIRGINIS—						
	3900.6	11.8	Pt,	3933.6	13.6	B.
	3905.6	12.0	B,	3934.7	13.1	Pt.
140528 RU HYDRAE—						
	3855.0	8.6	Bl,	3876.0	8.3	Bl,
	3868.0	8.7	Bl,	3906.0	8.9	Bl.
140959 R CENTAURI—						
	3855.0	9.9	Bl,	3885.1	10.3	Bl.
	3868.0	10.1	Bl,	3906.0	10.7	Bl.
	3876.0	10.2	Bl,			
141567 U URSAE MINORIS—						
	3885.2	8.7	Ch,	3910.6	9.7	M,
	3899.6	9.3	Kl,	3921.6	9.9	Al,
	3900.1	9.2	Ch,	3934.7	10.5	Pt.
	3900.6	8.8	Pt,			
141954 S BOOTIS—						
	3898.8	12.1	Pa,	3907.6	12.5	Y.
	3899.8	11.8	Cy,	3931.6	13.4	B,
	3900.6	12.2	Pt,	3934.7	13.5	Pt,
	3900.7	12.3	Br,	3939.6	13.8	B.
	3905.6	12.4	B,			
142205 RS VIRGINIS—						
	3907.7	11.2	Br,	3930.6	11.1	B.
	3918.6	10.7	B,			
142539 V BOOTIS—						
	3893.6	7.9	B,	3922.6	7.8	Ro,
	3895.6	7.9	Cy,	3924.5	7.9	Ro,
	3899.6	8.9	Ly,	3928.5	7.8	Ro,
	3899.6	8.0	Ro,	3931.5	7.7	Ro,
	3900.6	7.9	Pt,	3934.7	7.8	Pt,
	3900 8	7.5	Sg,	3935.7	7.9	Ca,
	3902.6	8.0	Al,	3939.6	7.8	B,
	3904.6	8.5	Ly,	3941.8	8 3	Mi.
	3907.8	7.8	Cy,	3942.5	7.9	Ro,
	3910.6	8.1	Ly,	3942.8	7.8	Ca.
	3911.8	8.0	M.	3943.7	8 0	Mi.
	3912.1	7.8	Ch,	3944.5	7.5	Ro,
	3912.7	8.2	Sg,	3946.9	8.0	Mi,
	3913.6	8.0	B,	3951.7	7.9	Mi,
	3914.6	8.0	Ro,	3953.7	7.9	Ca.
	3919.8	8.1	Cy,			
142584 R CAMELOPARDALIS—						
	3937.6	12.5	B.			
143227 R BOOTIS—						
	3890.2	9.7	Ch,	3914.6	7.9	Ro,
	3900.7	9.0	Br,	3916.7	8.0	Br,
	3900.8	8.9	Sg,	3919.8	7.7	Cy,
	3908.8	8.6	Ca,	3925.6	7.0	Ca,
143227 R BOOTIS—Continued.						
	3901.6	9.0	Ca.	3934.7	7.0	Pt.
	3907.8	8.6	Cy,	3935.8	6.6	Ca,
	3909.6	8.6	Ie,	3939.6	6.6	B,
	3910.6	8 3	M,	3940.8	6.6	Ca,
	3910.6	8.2	O,	3946.7	6.6	Ca,
	3912.7	8.3	Sg,	3953.7	7.0	Ca,
	3913.6	8.1	B,			
144918 U BOOTIS—						
	3908.6	10.6	B,	3932.6	10 3	B.
	3913.6	10.7	B,			
145254 Y LUPI—						
	3855.0	10.0	Bl,	3885.1	10.0	Bl,
	3868.0	10.1	Bl,	3906.0	10.2	Bl.
	3976.0	10.0	Bl,			
145971 S APODIS—						
	3885.0	10.0	Bl,	3885.1	10 1	Bl,
	3868.0	10.1	Bl,	3906.0	10.5	Bl.
	3876.0	10.3	Bl,			
150018 RT LIBRAE—						
	3900 6	11.2	Pt,	3934.7	12.6	Pt,
	3918.6	11.8	B,	3939.6	12.7	B.
	3930.6	12.4	B,			
150519 T LIBRAE—						
	3907.8	14.8	Pa,	3937.6	13.4	B.
150605 Y LIBRAE—						
	3900.6	9.2	Pt,	3934.7	8.4	Pt.
	3926.6	8.5	B,			
151520 S LIBRAE—						
	3885 2	9.5	Ch,	3910.2	8.6	Ch,
	3900.6	8.4	Pt,	3934.7	8.1	Pt.
151714 S SERPENTIS—						
	3900.7	12.2	Wf,	3916.7	12.0	Br.
	3908.7	12.0	Ca,	3928.6	11.9	Ca,
	3911.6	12.0	Kl,	3928.7	11.9	Wf,
	3913.6	11.9	B,	3930.7	11.3	B,
	3913.7	12.0	Wf,	3939.7	11.9	Wf.
151731 S CORONAE BOREALIS—						
	3898.0	10.6	Nk,	3912.7	10.1	Sg,
	3900.6	9.6	Pt,	3916.7	10.6	Br,
	3900.8	10.0	Sg,	3919.8	10.5	Cy,
	3901.6	9.8	Ca,	3934.7	10.8	Pt,
	3902.8	10.0	Cy,	3935.8	10.9	Ca,
	3904.7	10.3	Kl,	3940.6	10.9	B.
	3907.6	9.8	B,	3948.8	11.1	Gb.
	3911.8	9.8	M,			
151822 RS LIBRAE—						
	3855.0	7.8	Bl,	3906.0	9.8	Bl,
	3868.1	8.4	Bl,	3918.6	10.4	B,
	3876.0	8.7	Bl,	3930.6	11.4	B,
	3885.1	9.2	Bl,	3939.7	11.4	B.
152714 RU LIBRAE—						
	3899.8	9.4	Cy,	3930.6	11.4	B,
	3900.8	9.5	Pt,	3934.7	11.6	Pt,
	3910.8	10.5	Cy,	3940.6	11.8	B.
	3918.7	10.6	B,			
152849 R NORMAE—						
	3855.0	9.5	Bl,	3885.1	8.9	Bl,
	3868.1	9.1	Bl,	3906.0	8.0	Bl.
	3876.0	8.9	Bl,			

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
153020 X LIBRAE—						
	3855.0	10.8	Bl,	3885.1	11.7	Bl,
	3868 1	11.0	Bl,	3906.0	12.3	Bl.
	3876.0	11.3	Bl,			
153215 W LIBRAE—						
	3856.2	11.7	Bl,	3885.1	11.8	Bl,
	3868.1	11.8	Bl,	3906.0	12.4	Bl,
	3876.0	11.7	Bl,	3931.6	13.9	B.
153378 S URSAE MINORIS—						
	3895.6	8.5	Cy,	3919.7	8.6	Cy,
	3898 0	8.7	Nk,	3922.6	8.4	Ro,
	3899.6	8.9	Ro,	3923.7	8.5	Mo,
	3900.6	8.2	Pt,	3923.7	8.5	Hr,
	3900.8	8.0	Sg,	3924.5	8.4	Ro,
	3901.6	8.6	Ca,	3928.5	8.6	Ro,
	3907.8	8.5	Cy,	3928.6	8.5	Ca,
	3909.7	8.9	Ro,	3931.5	8.6	Ro,
	3910.6	8.8	Ro,	3934.7	8.4	Pt,
	3911.7	8.5	Kl,	3942.5	8.6	Ro,
	3911.8	8.3	M,	3942.8	8.7	Ca,
	3912 7	8.5	Sg,	3944.5	8.6	Ro.
153620 U LIBRAE—						
	3906.0	12.4	Bl.			
154428 R CORONAE BOREALIS—						
	3879.2	6.2	Ch,	3915.7	6.1	Wf,
	3880.2	6.2	Ch,	3916.7	6.0	Wf,
	3881.2	6.2	Ch,	3917.6	6.0	Kl,
	3884.2	6.2	Ch,	3917.7	6.2	Pt,
	3885.2	6.2	Ch,	3917.8	6.1	Wf,
	3885.3	6.1	Kd,	3918.7	6.2	Pt.
	3887.6	6.1	L,	3918.7	6.2	Wf,
	3895.6	6.3	Cy,	3919.6	6 3	Cy,
	3896.7	6.2	Sg,	3919.7	6.1	Pt,
	3897.2	6.3	Ch,	3919.7	6 2	Sg,
	3897.6	5.7	Kl,	3920.6	5.7	Kl,
	3898.1	6.1	Kd,	3922.6	6.2	Pt,
	3898 7	5.8	Gb,	3922.7	6.1	Wf,
	3299.6	5.9	Ly,	3923.6	6.4	Ca,
	3999 6	6.2	Pt,	3923.7	6.3	Hr,
	3899.8	6.3	Cy,	3924.6	6.1	Pt,
	3899.8	6.0	Sg,	3925.7	6.3	Ca,
	3900.6	6.2	Pt,	3925.7	6.1	Wf,
	3900.7	6.0	Ca,	3926.7	6.1	Ca,
	3900.7	6.0	Wf,	3926.7	6.1	Wf,
	3901.6	6.0	Ca,	3927.6	6.2	Pt,
	3902.2	6.1	Ch,	3928.5	5.9	Ro,
	3902 6	6.0	Ca,	3928.6	6.1	Ca,
	3902.6	6.2	Al,	3928.7	6.2	Pt,
	3902 6	6.0	O,	3928.7	6.1	Wf,
	3902.7	6.0	Wf,	3929.8	6.2	Wf,
	3902.8	6.3	Cy,	3931.6	6.1	Ca,
	3903.7	5.5	Kl,	3931.6	6 0	O,
	3904.6	6.0	Ly,	3931.7	6.2	Pt.
	3905.6	6.1	Pt,	3931.7	6.2	Wf,
	3905.6	6.1	Ca,	3933.7	6.2	Pt,
	3905.7	6.0	Wf,	3934.7	6.1	Pt,
	3906.6	5.6	Kl,	3934.7	6.2	Wf,
	3906.6	6.0	Gb,	3935.6	6.1	Ca,
	3906.7	6.0	Wf,	3935.7	6.2	Pt,
	3907.2	6.1	Ch.	3935.7	6.0	Wf,

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
154428 R CORONAE BOREALIS—Continued.						
	3907.6	6.1	Pt,	3936.6	6.2	Pt,
	3907.8	5.9	Hr,	3937.7	6.1	Ca,
	3907.8	6.0	Cy,	3937.9	6.2	Wf,
	3907.8	5.9	Ca,	3938.7	6.0	Wf,
	3908.6	6.1	B,	3939.7	6.2	Wf,
	3908.6	6.0	Pt,	3940.7	5.9	Ca,
	3908 6	6.0	Ca,	3942.6	6.0	O,
	3909.6	5.6	Kl.	3942.8	6.0	Ca,
	3909 9	6.1	Pt,	3943.6	6.1	Pt,
	3910.6	5.9	Ly,	3943.6	6.0	Mi,
	3910 6	6.2	Al,	3943.8	6.4	M,
	3910.6	6.1	Pt.	3944.5	5.9	Ro,
	3910.6	6.0	O,	3944.6	6.1	Mi,
	3910.7	6.3	Sg,	3944.7	6.0	Wf,
	3910.8	6.3	Cy,	3945.7	6.0	Ca,
	3911.2	6.2	Ch.	3946.6	6.0	Ca,
	3911.6	6.1	Cd.	3946.6	6.2	Pt,
	3911.6	5.5	Kl,	3946.9	6.0	Mi,
	3911.7	6.2	Pt,	3948.8	6.1	Pt,
	3911.7	6.2	Ca,	3948.8	6.0	Gb,
	3911.8	6.0	M.	3950.6	6.1	Pt,
	3912.6	6.1	Pt,	3951.6	6.0	Ca,
	3912.6	6.1	Ca,	3951.7	6.0	Mi,
	3912.6	6.3	Cy,	3951.8	6.1	Pt,
	3913.7	6.1	Wf.	3953.7	6.0	Ca,
	3913.8	6.0	M.	3955.6	6.0	Ca.
	3914.6	6.1	Ro,	3956.7	6.0	Ca,
	3914.8	6.2	Wf.	3972.6	6.0	Al.
154536 X CORONAE BOREALIS—						
	3900.6	9.2	Pt.	3916.8	9.0	Br,
	3900.7	9.4	Wf,	3931.7	9.3	Wf,
	3910.6	9.3	O,	3934.7	9.0	Pt.
	3913.7	9.5	Wf,	3939.7	9.5	Wf,
	3914.6	8.7	B.	3940.6	9.1	B.
154615 R SERPENTIS—						
	3885.2	7.5	Ch.	3911.8	8.2	M.
	3899.2	7.5	Ch,	3912.7	8.5	Ch,
	3899.8	8.0	Cy.	3913.6	8.5	B,
	3900.6	8.0	Pt,	3916.8	8.2	Br,
	3900 8	7.9	Sg,	3919.8	9.1	Cy,
	3902.6	8.1	Ca,	3928.6	8.9	Ca,
	3904 7	8.4	Kl.	3931.6	8.8	O,
	3908.7	8.4	Ca.	3934.7	8.9	Pt,
	3910.6	8.1	O.	3942.6	8.9	O.
	3010.8	8.3	Cy.	3948.6	9.2	O,
	3911.2	8.3	Ch.	3955.6	9.9	Ca.
154639 V CORONAE BOREALIS—						
	3900.6	9.1	Pt.	3929 7	9.9	Wf,
	3900.7	9.9	Wf,	3934.7	9.0	Pt,
	3912.6	10.2	Ca.	3939.7	9 9	Wf,
	3913.7	10.0	Wf,	3940.6	9.0	B.
	3918.6	9.4	B,	3953.8	8.8	Ca.
154715 R LIBRAE—						
	3937.7	13.4	B.			
154736 R LUPI—						
	3900.6	11.0	Pt.			
155018 RR LIBRAE—						
	3885.2	11 3	Ch,	3931.6	14.2	B.
	3900.6	12.6	Pt,			

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
155229 Z CORONAE BOREALIS—				
	3913.6	12.7 B,	3933.6	11.1 B,
155823 RZ SCORPII—				
	3900.6	10.5 Pt,	3934.7	9.4 Pt.
160021 Z SCORPII—				
	3856.2	11.0 Bl,	3885.1	11.6 Bl,
	3868.1	11.2 Bl,	3906.0	10.9 Bl.
	3876.0	11.8 Bl,		
160118 R HERCULIS—				
	3885.2	11.0 Ch,	3916.8	12.8 Br,
	3900.6	13.1 Pt,	3918.6	12.8 B,
	3911.8	12.0 M,	3933.6	13.7 B.
160210 U SERPENTIS—				
	3906.7	13.5 Sg,	3933.6	12.8 B,
	3911.8	12.2 M,	3935.7	12.5 Ca.
	3912.0	10.9 Nk,		
*160221*a X SCORPII—				
	3856.2	12.9 Bl,	3885.1	11.6 Bl.
	3876.0	12.2 Bl,	3906.0	10.9 Bl.
160519 W SCORPII—				
	3880.2	13.7 Bl,	3906.0	12.0 Bl.
160625a RU HERCULIS—				
	3900.6	12.0 Pt,	3931.7	12.7 Wf,
	3900.7	13.0 Wf,	3934.7	12.0 Pt,
	3908.7	13.4 B,	3939.7	12.2 Wf,
	3913.7	13.0 Wf,	3940.7	11.4 B.
160625b SX HERCULIS—				
	3899.6	8.7 Pt,	3927.6	8.0 Pt,
	3900.6	8.8 Pt,	3928.7	7.9 Pt,
	3900.7	8.9 Wf,	3929.7	7.9 Wf,
	3905.6	8.7 Pt,	3931.7	7.9 Pt,
	3907.6	8.6 Pt,	3933.7	8.1 Pt,
	3908.6	8.5 Pt,	3934.7	8.0 Pt,
	3910.6	8.5 Pt,	3935.7	7.9 Pt,
	3911.7	8.6 Pt,	3936.6	8.0 Pt,
	3912.6	8.4 Pt,	3939.7	8.0 Wf,
	3913.7	8.3 Wf,	3943.6	8.0 Pt,
	3918.7	8.0 Pt,	3948.8	8.1 Pt.
	3919.7	8.0 Pt,	3950.6	8.0 Pt,
	3922.6	7.9 Pt.	3951.8	8.2 Pt.
	3924.6	7.9 Pt.		
*161122*a R SCORPII—				
	3856.2	12.0 Bl,	3900.8	12.0 M,
	3868.1	10.4 Bl,	3906.0	10.4 Bl,
	3876.0	10.0 Bl,	3907.8	10.0 Pt,
	3885.1	9.9 Bl,	3935.7	12.6 Pt.
*161122*b S SCORPII—				
	3856.2	10.2 Bl,	3885.1	12.1 Bl,
	3868.1	10.3 Bl,	3906.0	12.8 Bl.
	3976.0	11.7 Bl,		
*161122*c T SCORPII—				
	3900.8	10.2 M.		
161138 W CORONAE BOREALIS—				
	3901.6	11.0 Ca,	3917.6	9.4 B,
	3907.6	10.4 Y,	3931.6	9.6 Ca,
	3907.8	10.1 Pt.	3935.7	10.0 Pt.
	3910.6	10.5 O,	3940.6	9.6 B,
	3912.6	10.3 Ca,	3940.8	10.1 Ca,
	3916.8	9.7 Br,	3943.8	9.7 M.
161607 W OPHIUCHI—				
	3907.8	13.7 Pt.	3935.7	14.2 Pt.
	3933.6	13.8 B,		
162112 V OPHIUCHI—				
	3900.2	8.0 Ch,	3928.7	7.8 Ca,
	3907.8	7.3 Pt,	3935.7	7.7 Pt,
	3908.6	7.0 Ca,	3956.7	8.2 Ca.
	3926.6	7.6 B,		
162119 U HERCULIS—				
	3900.2	7.1 Ch,	3926.6	7.1 B,
	3900.8	7.1 Sg,	3928.6	7.1 Ca,
	3901.6	6.7 Ca,	3931.6	7.7 O,
	3907.8	7.0 Pt,	3935.7	7.7 Pt,
	3908.6	6.7 Ca,	3942.6	7.8 O,
	3909.6	7.0 Ie,	3942.6	7.6 Ca,
	3911.8	7.0 M,	3943.8	8.0 M,
	3912.7	7.4 Sg,	3946.6	8.3 O,
	3916.8	7.3 Br,	3953.8	7.8 Ca.
	3925.7	6.9 Ca,		
162319 Y SCORPII—				
	3907.8	14.5 Pa.		
162807 SS HERCULIS—				
	3907.8	12.1 Pt.	3935.7	11.9 Pt,
	3908.7	12.3 B,	3940.6	10.8 B.
	3916.8	13.0 Br,		
162815 T OPHIUCHI—				
	3856.2	10.0 Bl,	3907.8	10.5 Pt,
	3868.1	9.7 Bl,	3930.7	11.3 B,
	3876.0	9.4 Bl,	3935.7	11.3 Pt,
	3885.1	9.5 Bl,	3939.7	11.5 B.
	3906.0	10.3 Bl,		
162816 S OPHIUCHI—				
	3885.6	10.6 Bl,	3880.2	12.3 Bl,
	3868.2	11.7 Bl,	3937.6	13.6 B.
163137 W HERCULIS—				
	3907.6	13.6 Y,	3935.6	12.3 B,
	3907.8	14.0 Pt,	3935.7	12.5 Pt,
	3916.9	13.5 Br,	3942.6	9.3 Ca,
163172 R URSAE MINORIS—				
	3910.6	9.4 M,	3926.6	9.2 B.
163266 R DRACONIS—				
	3879.2	7.3 Ch,	3910.6	8.0 M,
	3885.2	7.2 Ch,	3911.5	7.9 Ca,
	3895.2	7.3 Ch,	3925.7	8.6 Ca,
	3901.6	7.5 Ca,	3935.7	9.0 Pt,
	3907.8	7.7 Pt,	3942.6	9.4 Ca.
	3910.2	7.8 Ch,		
164319 RR OPHIUCHI—				
	3907.8	10.4 Pt.	3935.7	11.5 Pt.
	3926.6	10.6 B,	3940.6	11.4 B.
164715 S HERCULIS—				
	3902.7	11.6 Ca,	3935.7	9.2 Pt,
	3907.8	10.4 Pt,	3942.6	9.4 O,
	3911.8	10.0 M,	3942.6	9.1 Ca,
	3926.7	9.3 Ca,	3943.8	9.3 M,
	3926.6	9.5 B,	3953.8	8.6 Ca.
164844 RS SCORPII—				
	3855.0	10.5 Bl,	3885.1	8.0 Bl,
	3868.2	9.8 Bl,	3906.0	7.1 Bl.
	3876.0	9.0 Bl,		

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
165030 RR SCORPII—						
	3856.2	9.0	Bl.	3880.2	8.5	Bl.
	3868.2	8.4	Bl.	3906.0	7.1	Bl.
165631 RV HERCULIS—						
	3811.3	10.7	Nk.	3935.7	14.7	Pt.
	3899.1	14.3	Nk.	3939.6	13.9	B.
170215 R OPHIUCHI—						
	3901.8	11.5	M.	3928.7	10.1	Ca.
	3902.8	11.4	Cy.	3930.7	9.7	B.
	3907.8	11.4	Cy.	3935.7	9.5	Pt.
	3907.8	11.5	Pt.	3944.7	9.1	Mi.
	3908.7	11.3	Ca.	3946.6	8.7	Ca.
	3911.7	11.5	Kl.	3955.6	8.4	Ca.
170627 RT HERCULIS—						
	3900.7	11.6	Wf.	3935.7	10.6	Pt.
	3907.8	11.0	Pt.	3939.6	10.3	B.
	3913.8	11.0	Wf.	3939.8	10.4	Wf.
	3916.9	10.5	Br.	3942.6	11.0	O.
	3929.7	10.2	Wf.	3948.6	10.5	O.
	3930.7	10.3	B.			
170833 RW SCORPII—						
	3876.1	12.1	Bl.	3906.0	10.3	Bl.
	3880.2	11.7	Bl.			
171401 Z OPHIUCHI—						
	3901.7	10.1	Ca.	3933.7	11.5	B.
	3907.8	10.6	Pt.	3935.7	11.5	Ca.
	3916.9	10.0	Br.	3935.7	11.6	Pt.
171723 RS HERCULIS—						
	3811.2	9.0	Nk.	3906.2	10.0	Nk.
	3865.1	9.0	Nk.	3907.8	9.8	Pt.
	3866.2	8.7	Nk.	3913.8	10.7	Wf.
	3875.1	8.7	Nk.	3916.9	10.2	Br.
	3885.1	9.0	Nk.	3930.7	11.4	B.
	3898.1	9.5	Nk.	3931.7	11.4	Wf.
	3899.1	9.6	Nk.	3935.7	12.4	Pt.
	3900.8	9.4	Wf.	3939.8	12.1	Wf.
172486 S OCTANTIS—						
	3856.2	12.3	Bl.	3885.1	10.0	Bl.
	3868.2	11.3	Bl.	3906.1	9.5	Bl.
	3876.0	10.5	Bl.			
172809 RU OPHIUCHI—						
	3907.8	12.7	Pt.	3935.7	13.8	Pt.
173543 RU SCORPII—						
	3856.2	13.0	Bl.	3906.1	12.0	Bl.
	3880.2	12.3	Bl.			
174406 RS OPHIUCHI—						
	3907.8	11.1	Pt.	3935.7	11.0	Pt.
175111 RT OPHIUCHI—						
	3907.8	10.1	Pt.	3935.7	11.1	Pt.
175458a T DRACONIS—						
	3936.7	11.2	B.			
175519 RY HERCULIS—						
	3907.8	11.0	Pt.	3935.7	9.3	Pt.
	3931.6	9.6	B.			
175654 V DRACONIS—						
	3907.8	10.6	Pt.	3935.7	12.6	Pt.
180531 T HERCULIS—						
	3810.2	8.8	Nk.	3908.7	11.3	Ca.
	3865.1	8.6	Nk.	3908.8	10.5	Sg.
	3866.2	9.0	Nk.	3910.6	11.0	Ie.
	3902.3	10.9	Ch.	3916.9	11.2	Br.
	3904.2	10.2	Nk.	3931.6	12.6	Ca.
	3906.2	10.8	Nk.	3935.7	12.4	Pt.
	3907.8	10.8	Pt.	3943.8	10.5	M.
180666 X DRACONIS—						
	3907.8	13.6	Pt.			
180911 NOVA OPHIUCHI 24—						
	3907.8	13.7	Pt.			
181103 RY OPHIUCHI—						
	3907.8	12.6	Pt.			
181136 W LYRAE—						
	3901.7	9.3	Ca.	3931.6	10.3	O.
	3907.8	9.4	Pt.	3935.8	10.8	Ca.
	3908.8	10.0	Sg.	3935.7	10.6	Pt.
	3925.6	10.3	Ca.			
182133 RV SAGITTARII—						
	3856.2	8.0	Bl.	3880.2	7.7	Bl.
	3868.2	7.5	Bl.	3906.1	8.0	Bl.
182224 SV HERCULIS—						
	3942.6	10.2	O.	3944.6	10.5	O.
183308 X OPHIUCHI—						
	3866.2	7.2	Nk.	3908.8	8.0	Ca.
	3899.8	8.0	Cy.	3928.7	8.2	Ca.
	3906.2	7.9	Nk.	3935.7	8.0	Pt.
	3907.8	7.8	Pt.	3056.7	8.5	Ca.
	3907.8	8.0	Cy.			
184134 RY LYRAE—						
	3907.8	14.1	Pt.			
184205 R SCUTI—						
	3824.2	5.7	Ks.	3912.7	5.7	Ca.
	3862.2	6.5	Ks.	3919.8	5.8	Cy.
	3866.2	5.9	Nk.	3922.8	5.6	Pt.
	3867.2	6.3	Ks.	3925.7	5.5	Ca.
	3875.3	7.2	Kd.	3926.7	5.4	Ca.
	3881.4	7.4	Ch.	3928.7	5.5	Pt.
	3881.6	8.2	Sl.	3928.7	5.5	Ca.
	3885.3	7.4	Kd.	3934.7	5.5	Pt.
	3887.6	7.2	L.	3935.7	5.7	Pt.
	3890.4	7.0	Ch.	3935.7	5.5	Ca.
	3892.4	6.6	Ch.	3937.7	5.6	Ca.
	3895.3	6.5	Kd.	3940.7	5.7	Ca.
	3895.8	6.5	Ie.	3941.7	5.7	Mi.
	3899.8	5.8	Cy.	3941.7	5.0	Gb.
	3900.8	5.2	M.	3942.7	5.5	Ca.
	3901.7	5.9	Ca.	3942.8	5.0	Gb.
	3902.1	5.9	Ks.	3943.8	5.5	Mi.
	3902.7	5.8	Ca.	3943.8	5.5	Pt.
	3906.8	5.5	Gb.	3944.7	5.5	Mi.
	3907.2	5.8	Ch.	3945.7	5.6	Ca.
	3907.8	5.7	Ca.	3946.6	5.5	Ca.
	3907.8	5.0	Cy.	3944.8	5.4	Pt.
	3907.8	6.0	Pt.	3948.8	5.0	Gb.
	3908.8	5.7	Ca.	3950.7	5.0	Gb.
	3909.8	5.8	Gb.	3951.6	5.4	Ca.
	3909.9	6.0	Pt.	3951.7	5.5	Mi.
	3910.2	5.8	Ch.	3951.8	5.4	Pt.

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
184205 R SCUTI—Continued.				
	3910.6	6.0 Pt,	3953.7	5.3 Ca,
	3910.8	5.5 Cy,	3955.6	5.3 Ca,
	3911.7	5.7 Ca,	3956.7	5.3 Ca.
	3911.7	5.6 Kl,		
184243 RW LYRAE—				
	3907.8	12.0 Pt,	3936.6	12.5 B,
	3933.7	12.6 B,	3940.7	12.2 B.
	3935.7	12.6 Pt,		
184300 NOVA AQUILAE #3—				
	3881.4	10.4 Ch,	3931.5	10.6 Ro,
	3866.2	10.4 Nk,	3934.7	10.8 Pt,
	3900.8	10.3 M,	3937.5	10.6 Ro,
	3907.8	10.6 Pt,	3940.7	10.4 Ca,
	3908.8	10.3 Ca,	3943.8	10.6 Pt,
	3909.7	10.5 Ro,	3944.5	10.6 Ro,
	3922.8	10.6 Pt,	3945.5	10.6 Ro,
	3928.7	10.5 Pt,	3948.8	10.7 Pt.
185437 S CORONAE AUSTRALIS—				
	3856.2	11.5 Bl,	3885.1	11.6 Bl,
	3868.2	11.8 Bl,	3906.1	11.6 Bl.
	3880.2	11.5 Bl,		
*185513*a ST SAGITTARII—				
	3881.4	8.2 Ch,	3892.4	8.5 Ch,
	3887.6	9.1 L,	3908.4	10.0 Ch.
*185537*a R CORONAE AUSTRALIS—				
	3856.2	12.9 Bl,	3885.2	11.5 Bl.
	3880.2	11.4 Bl,		
*185537*b T CORONAE AUSTRALIS—				
	3856.2	14.0 Bl.		
185634 S LYRAE—				
	3907.8	10.6 Pt,	3940.7	13.1 B,
	3935.7	12.2 Pt.		
190108 R AQUILAE—				
	3907.8	7.1 Pt,	3935.7	8.5 Pt,
	3908.8	7.2 Ca,	3942.7	9.1 Ca,
	3910.3	8.2 Ch,	3956.7	10.5 Ca.
	3928.8	8.3 Ca,		
190529a V LYRAE—				
	3907.8	11.6 Pt,	3935.7	9.8 Pt,
	3916.9	10.8 Br,	3946.6	10.2 O.
190819 RW SAGITTARII—				
	3892.4	10.6 Ch,	3935.7	9.6 Pt.
	3907.8	10.0 Pt,		
190907 TY AQUILAE—				
	3907.8	10.6 Pt,	3935.7	10.4 Pt.
190926 X LYRAE—				
	3907.8	8.9 Pt,	3935.7	9.0 Pt.
190933a RS LYRAE—				
	3907.8	11.0 Pt,	3935.7	10.8 Pt.
190941 RU LYRAE—				
	3907.8	15.0 Pa.		
190967a U DRACONIS—				
	3907.8	13.4 Pt,	3935.7	12.6 Pt.
191007 W AQUILAE—				
	3907.8	8.0 Pt,	3935.8	8.2 Pt.
191017 T SAGITTARII—				
	3907.8	10.1 Pt,	3935.7	9.4 Pt.
191019 R SAGITTARII—				
	3907.8	12.1 Pt,	3942.8	11.3 Ca.
	3935.7	12.4 Pt,		
191033 RY SAGITTARII—				
	3856.2	9.1 Bl,	3906.1	9.4 Bl,
	3868.2	9.3 Bl,	3907.8	9.7 Pt,
	3980.2	9.0 Bl,	3908.4	10.0 Ch,
	3881.4	9.3 Ch,	3909.8	10.0 Pt,
	3985.1	9.1 Bl,	3943.8	10.5 Pt,
	3887.6	9.2 L,	3948.8	10.6 Pt.
	3892.4	9.3 Ch,		
191124 TY SAGITTARII—				
	3856.2	12.6 Bl,	3880.2	13.8 Bl.
191319 S SAGITTARII—				
	3856.2	10.5 Bl,	3880.2	11.4 Bl,
	3868.2	10.9 Bl,	3907.8	12.9 Pt.
191331 SW SAGITTARII—				
	3856.2	11.9 Bl,	3880.2	10.4 Bl,
	3868.2	11.2 Bl,	3885.1	10.6 Bl.
191350 TZ CYGNI—				
	3935.7	11.2 Pt.		
191637 U LYRAE—				
	3907.8	8.6 Pt,	3935.7	9.5 Pt.
	3931.6	10.1 O,		
193311 RT AQUILAE—				
	3890.4	10.6 Ch,	3935.7	8.5 Pt,
	3907.8	9.5 Pt,	3952.6	9.0 O.
	3916.9	9.0 Br,		
193449 R CYGNI—				
	3909.8	13.9 Pt,	3935.7	12.4 Pt,
	3931.6	13.0 Ca,	3944.7	12.8 Mi.
193972 T PAVONIS—				
	3855.0	10.5 Bl,	3880.2	11.7 Bl.
	3868.2	11.5 Bl,		
194048 RT CYGNI—				
	3881.4	7.8 Ch,	3907.8	9.0 Cy,
	3890.4	8.3 Ch,	3909.7	9.3 Gb,
	3995.8	8.4 Cy,	3909.8	9.2 Pt,
	3901.7	9.0 Ca,	3910.3	9.3 Ch,
	3901.8	8.8 M,	3911.7	9.7 Ca,
	3905.4	9.3 Ch,	3918.8	9.8 Sg,
	3906.8	9.0 Gb,	3935.7	11.6 Pt.
194348 TU CYGNI—				
	3881.4	10.6 Ch,	3909.8	9.1 Pt,
	3890.4	9.7 Ch,	3910.3	9.2 Ch,
	3901.8	9.3 M,	3935.7	10.0 Pt.
	3905.4	9.2 Ch,		
194604 X AQUILAE—				
	3900.8	12.8 Wf,	3931.8	13.8 Wf,
	3909.8	12.8 Pt,	3938.7	14.1 Wf,
	3913.8	13.0 Wf,	3944.8	14.0 Wf.
194632 χ CYGNI—				
	3866.2	10.5 Nk,	3906.2	11.5 Nk,
	3881.4	11.2 Ch,	3909.8	12.0 Pt,
	3900.8	11.4 M,	3935.7	12.4 Pt.
	3904.1	11.4 Nk,		
094920 RR SAGITTARII—				
	3856.2	10.3 Bl,	3880.2	11.7 Bl.
	3868.2	10.9 Bl,		

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
195142 RU SAGITTARII—						
	3856.3	11.2	Bl,	3880.2	8.0	Bl.
	3868.2	9.9	Bl,			
195202 RR AQUILAE—						
	3909.8	12.2	Pt,	3935.8	9.3	Pt.
195553 NOVA CYGNI 23—						
	3899.6	11.2	Pt,	3931.7	11.2	Pt,
	3907.8	11.1	Pt,	3933.7	11.1	Pt,
	3908.7	11.7	Ca,	3935.6	11.8	Ca,
	3909.8	11.2	Pt,	3935.7	11.0	Pt,
	3911.7	11.2	Pt,	3943.6	11.3	Pt,
	3922.8	11.2	Pt,	3948.8	11.2	Pt.
	3927.6	11.4	Pt,			
195849 Z CYGNI—						
	3900.8	12.4	Pt,	3913.8	13.0	Wf,
	3901.8	12.4	M,	3931.8	12.3	Wf,
	3906.2	11.8	Nk,	3938.7	11.4	Wf,
	3909.8	12.4	Pt,	3943.8	11.0	Pt.
195855 S TELESCOPII—						
	3856.3	12.6	Bl,	3880.2	12.3	Bl.
200212 SY AQUILAE—						
	3887.6	11.0	L,	3943.8	11.9	Pt.
	3909.8	11.1	Pt,			
200514 R CAPRICORNI—						
	3909.8	10.4	Pt,	3943.8	11.5	Pt.
200715a S AQUILAE—						
	3909.8	9.7	Pt,	3944.8	11.0	M.
	3943.8	9.8	Pt,			
200715b RW AQUILAE—						
	3909.8	9.1	Pt,	3944.8	8.8	M.
	3943.8	9.0	Pt,			
200747 R TELESCOPII—						
	3856.3	12.8	Bl,	3880.2	13.4	Bl.
200822 W. CAPRICORNI—						
	3856.3	13.3	Bl,	3909.8	12.5	Pt.
	3880.2	11.2	Bl,			
200906 Z AQUILAE—						
	3909.8	13.4	Pt,	3943.8	10.3	Pt.
200916 R SAGITTAE—						
	3944.8	8.8	M.			
200938 RS CYGNI—						
	3881.4	7.2	Ch,	3901.8	8.3	M,
	3887.6	6 8	L,	3907.8	7.4	Cy,
	3890.4	7.2	Ch,	3918.8	7.2	Sg,
	3895.8	7.4	Cy,	3937.7	13.0	Al,
	3898.4	6.9	Ch,	3943.8	7.3	Pt,
	3899.8	7.5	Cy,	3956.6	7.5	Al.
201008 R DELPHINI—						
	3909.8	12.3	Pt.	3943.8	13.0	Pt.
201121 RT CAPRICORNI—						
	3909.8	6.5	Pt.	3943.8	6.3	Pt.
201130 SX CYGNI—						
	3909.8	13.0	Pt,	3944.6	9.4	O,
	3911.8	11.7	M,	3948.6	9.4	O.
	3943.8	8.9	Pt,			
201130 RT SAGITTARII—						
	3856.3	11.7	Bl,	3880.2	12.3	Bl.
	3868.2	12.1	Bl,			
201437b WX CYGNI—						
	3901.8	12.5	M,	3943.8	11.1	Pt.
	3909.8	12.6	Pt,			
201647 U CYGNI—						
	3898.8	10.0	M,	3935.7	8.7	Ca,
	3901.7	9.9	Ca,	3943.8	10.0	M,
	3906.2	9.6	Nk,	3943.8	8.7	Pt,
	3909.8	8.4	Pt,	3944.5	9.0	Ro,
	3925.7	6.6	Ca,	3945.5	8.9	Ro,
	3931.5	9.8	Ro,	3956.7	8.5	Ca.
202240 U MICROSCOPII—						
	3856.3	10.2	Bl,	3880.2	10.6	Bl.
	3868.2	10.3	Bl,			
202946 SZ CYGNI—						
	3907.8	8.8	Pt,	3934.7	9.2	Pt,
	3909.8	9.0	Pt,	3935.7	8.8	Pt,
	3911.7	9.5	Pt,	3943.6	9.2	Pt,
	3922.8	8.7	Pt,	3947.6	9.5	Pt,
	3927 6	9.6	Pt,	3948.8	9.5	Pt,
	3928.7	9.6	Pt,	3950.6	8.8	Pt,
	3931.7	9.9	Pt,	3951.8	8.8	Pt.
	3933.7	9.6	Pt,			
202954 ST CYGNI—						
	3909.8	12.5	Pt,	3943.8	13.0	Pt.
203226 V VULPECULAE—						
	3900.8	9.0	M,	3943.8	8.5	Pt.
	3909.8	8.5	Pt,			
203429 R MICROSCOPII—						
	3856.3	13.2	Bl,	3880.2	10.7	Bl.
203816 S DELPHINI—						
	3906.2	9.2	Nk,	3943.8	9.0	Pt.
	3909.8	9.1	Pt,			
203847 V CYGNI—						
	3981.4	10.4	Ch,	3909.8	8.6	Pt,
	3990.4	10.4	Ch,	3943.8	9.9	Pt.
	3998.8	10.0	M,			
204016 T DELPHINI—						
	3907.8	14 3	Pa,	3931.8	14.6	Wf,
	3913.8	14.8	Wf,	3938.7	14.3	Wf.
204102 V AQUARII—						
	3909.8	8.7	Pt,	3943.8	8.7	Pt.
204215 U CAPRICORNI—						
	3880.3	13.0	Bl.			
204405 T AQUARII—						
	3943.8	9.4	Pt,	3946.7	8.9	Pt.
204846 RZ CYGNI—						
	3900 8	13.6	Wf,	3934.7	14.1	Wf,
	3909.8	13.7	Pt,	3939.8	14.1	Wf,
	3913.8	14.0	Wf,	3943.8	13.3	Pt.
204954 S INDI—						
	3856.3	10.5	Bl,	3880.2	10.7	Bl.
	3868.2	10.5	Bl,			
205923 R VULPECULAE—						
	3901.8	9.5	M,	3943.8	12.1	Pt.
	3909.8	10.5	Pt,			
210121 V CAPRICORNI—						
	3856.3	9.5	Bl,	3880.3	10.3	Bl.
	3868.2	9.8	Bl,			
210504 RS AQUARII—						
	3909.8	9.8	Pt,	3943.8	10.5	Pt.

VARIABLE STAR OBSERVATIONS, April 20 to June 20, 1924—Continued.

Star	J.D.	Est.Obs.	J.D.	Est.Obs.
210812 R EQUULEI—				
	3900.9	9.9 Wf,	3939 8	9.3 Wf,
	3909.8	9.4 Pt,	3943.8	9.4 Pt.
	3931.8	9.7 Wf,		
210868 T CEPHEI—				
	3890.4	8.0 Ch,	3935.7	6.3 Ca,
	3896.3	7.6 Ch,	3943.8	6.3 Pt,
	3901.8	7.9 M,	3944.6	6.5 O,
	3908.4	7.5 Ch,	3946.6	6.3 Ca,
	3909.9	6.8 Pt,	3953.6	6.2 Ca.
	3911.7	7.4 Kl,		
210503 RR AQUARII—				
	3909.9	11.8 Pt,	3943.8	12.8 Pt.
211614 X PEGASI—				
	3909.9	12.1 Pt,	3943.8	10.0 Pt.
211615 T CAPRICORNI—				
	3856.3	11.6 Bl,	3880.3	9.8 Bl.
213244 W CYGNI—				
	3885.3	6.3 Kd,	3895.3	6.2 Kd.
213678 S CEPHEI—				
	3909.9	8.4 Pt,	3943.8	8.4 Pt.
213753 RU CYGNI—				
	3900.8	8.3 M,	3943.8	8.4 Pt,
	3909.9	8.4 Pt,	3943.8	9.2 M.
213843 SS CYGNI—				
	3866.2	11.1 Nk,	3922.7	11.8 Wf,
	3887.6	10.8 L,	3922.8	11.8 Pt.
	3881.4	11.8 Ch,	3924.7	11.2 Wf,
	3890.4	10.0 Ch,	3935.2	11.2 Ca,
	3892.4	8.6 Ch,	3926.7	11.2 Wf,
	3895.8	8.4 Ie,	3926.7	11.2 Ca,
	3895.8	8.4 Cy,	3928.7	11.5 Wf,
	3896.4	8.3 Ch,	3928.7	11.3 Ca,
	3898.4	8.3 Ch,	3928.7	11.6 Pt,
	3899.8	8.5 Wf,	3929.8	11.6 Wf,
	3899.9	8.4 Cy,	3931.5	9.4 Ro,
	3900.7	8.3 Ca,	3931.7	9.3 Wf,
	3900.8	8.4 M,	3931.8	8.8 Wf,
	3900.8	8.6 Wf,	3934.7	8.8 Wf,
	3901.7	8.7 Ca,	3934.7	8.9 Pt,
	3901.8	8.6 M,	3935.6	9.2 Ca,
	3902.7	9.0 Ca,	3935.7	9.0 Wf,
	3902.7	8.7 Wf,	3935.7	9.5 Pt.
	3902.8	8.8 Cy,	3937.5	11.2 Ro,
	3903.7	9.0 Cy,	3937.6	10.2 M,
	3904.7	9.4 Kl,	3937.7	10.0 Ca,
	3905.4	9.3 Ch,	3937.8	10.2 Wf,
	3905.7	9.2 Wf,	3938.8	10.6 Wf,
	3906.2	8.8 Nk,	3939.8	10.7 Wf,
	3906.7	9.8 Wf,	3940.7	11.5 Ca,
	3907.8	10.2 Cy.	3942.5	11.6 Ro,
	3908.4	9.9 Ch,	3942.6	10.5 O,
	3908.7	10.7 Ca,	3942.7	11.1 Ca,
	3910.7	11.0 Ie,	3943.8	11.3 Pt,
	3910.8	11.0 Cy,	3943.8	10.6 M,
	3911.7	10.4 Kl,	3944.5	11.8 Ro,
	3911.7	11.1 Ca,	3944.7	11.5 Wf,
	3911.8	11.3 Wf,	3944.8	10.7 M,
213843 SS CYGNI—				
	3911.8	10.3 M,	3946.6	11.2 O,
	3912.7	11.2 Ca,	3946.7	11.2 Ca,
	3913.8	11.4 Wf,	3948.6	10.9 O,
	3914.8	11.4 Wf,	3948.8	11.7 Pt,
	3915.8	11.5 Wf,	3950.6	[9.6 Pt,
	3916.7	11.5 Wf,	3951.6	11.5 Ca,
	3916.9	11.9 Br	3951.8	11.0 Pt,
	3917.8	11.8 Wf,	3953.7	11.3 Ca,
	3918.7	11.8 Wf,	3955.6	11.4 Ca,
	3921.7	11.3 Wf,	3956.7	11.3 Ca.
213937 RV CYGNI—				
	3900.8	8.3 M,	3943.8	6.7 Pt.
	3909.9	6.6 Pt,		
214024 RR PEGASI—				
	3900.9	9.4 Wf,	3939.8	10.1 Wf,
	3909.9	9.0 Pt,	3943.8	9.7 Pt.
	3931.8	9.9 Wf,		
215605 Y PEGASI—				
	3909.9	10.5 Pt,	3943.8	8.3 Pt.
215717 U AQUARII—				
	3943.8	11.8 Pt.		
215934 RT PEGASI—				
	3909.9	11.4 Pt,	3943.8	11.2 Pt.
220133a RY PEGASI—				
	3943.8	11.1 Pt.		
222439 S LACERTAE—				
	3943.8	9.2 Pt.		
222867 R INDI—				
	3854.9	9.0 Bl,	3880.3	9.9 Bl.
	3868.2	9.5 Bl,		
223841 R LACERTAE—				
	3887.6	11.5 L.		
225914 RW PEGASI—				
	3943.8	12.9 Pt.		
230130 R PEGASI—				
	3935.8	9.1 Ca,	3943.8	9.2 Pt.
230759 V CASSIOPEIAE—				
	3943 8	10.6 Pt,	3944.7	10.5 Mi,
	3943.8	10.4 Mi,	3953.7	9.9 Ca.
231508 S PEGASI—				
	3943.8	10.3 Pt.		
232848 Z ANDROMEDAE—				
	3943.8	9.7 Pt.		
233335 ST ANDROMEDAE—				
	3937.7	11.5 Ca,	3943.8	10.4 Pt.
233815 R AQUARII—				
	3943.8	8.6 Pt.		
233956 Z CASSIOPEIAE—				
	3900 8	13.5 Wf,	3934.7	13.3 Wf,
	3913.8	13.4 Wf,	3944.7	13.2 Wf.
235350 R CASSIOPEIAE—				
	3901.8	7.4 Ca,	3925.8	8.3 Ca,
	3902.8	8.1 Cy,	3951.6	8.6 Ca.
235525 Z PEGASI—				
	3943.8	12.8 Pt.		
235939 SV ANDROMEDAE—				
	3943.8	10.4 Pt.		

The following observers contributed to this report: Messrs. Allen "Al", Baldwin "Bl", Bouton "B", Brocchi "Br", Carr "Ca", Chandler "Cd", Chandra "Ch", Cilley "Cy", Gaebler "Gb", Henry "Hr", Icdema "Ie", Jones "Js", Kanda "Kd", Kasai "Ks", Kleis "Kl", Lacchini "L", Leavenworth "Lv", Mrs. Lytle "Ly", McAteer "M", McHenry "Mn", Mitchell "Mi", Miyajima "Mj", Munson "Mo", Murata "Mt", Nakamura "Nk", Olcott "O", Parkhurst "Pa", Peltier "Pt", Rhorer "Ro", Schüller "Sl", Skaggs "Sg", Waterfield, "Wf", Yalden "Ya", and Miss Young "Y".

	Totals		
	Apr. 20-May 20	May 20-June 20	Totals
Observations:	1542	804	2346
Stars observed			325
Observers:	32	12	33

In order to prepare the copy for the printer as soon as possible for this issue of POPULAR ASTRONOMY not all of the May-June observations were included in this report. These will be published next time.

HOWARD O. EATON, Recording Secretary.

COMMUNICATIONS.

A Brilliant Meteor. — On the evening of May 22 at 7:54 p. m. Eastern Standard Time I noticed a large "fireball" meteor near the western horizon. It was first noticed to appear at a point near α Monocerotis, moving slowly eastward in an arc, leaving a train of red and green which lasted for about 3 seconds, and finally disappearing at a point mid-way between 9 and 16 Puppis. It was very brilliant, about magnitude —5, and formed together with Venus, not far off to the northwest, an altogether inspiring spectacle. No explosion was heard. At first I thought the meteor was fireworks. ROBERT G. STONE.

Schenectady, N. Y.

Transit of Mercury. —Times of contact at the Drake University Municipal Observatory, latitude 41 degrees 36 minutes north, longitude 6 hours 14 minutes 36.6 seconds, were as follows:

Computed—External 9 hours 42 minutes 43.1 seconds, G.M.T.
Internal 9 hours 45 minutes 42.5 seconds.

Observed—When planet was first recognized 9 hours 42 minutes 54.5 seconds, G.M.T.
When planet was judged to be internally tangent to the sun's limb 9 hours 44 minutes 52 seconds.

I have been considerably concerned to note that this is fifty seconds of time earlier than the computed time of contact. D. W. MOREHOUSE.

A Brilliant Meteor. —While standing near the photographic zenith tube house at about 11:55 p. m., E. S. T., on the night of June 25, 1924, facing westward, our attention was suddenly arrested by a brilliant illumination in the eastern sky. Turning around immediately, we saw what was apparently a brilliant meteor, of almost dazzling brightness, light green in color, casting well-defined shadows, and illuminating the landscape with an intensity of light at least equal to that of the full moon. It resembled a rather well defined globular mass of greenish vapor, and descended in an oblique direction to the southward,

its path being inclined about 45° to the horizon. On completing about two-thirds of its course, the green disk suddenly collapsed into a red star-like object, somewhat brighter than Mars, near which it disappeared. Its duration was estimated as from one to two seconds. There was no trail, and no noise was heard.

The following are the approximate coördinates of the ends of its path:

	R.A.	Decl.	Azimuth from N thru E	Altitude
First seen	22^h4	+13°	95°	27°
End	22.4	—13	115	10

F. B. Littell and J. E. Willis.

(Communicated by Captain Edwin T. Pollock, U. S. Navy, Superintendent U. S. Naval Observatory.)

A Zigzag Meteor.—Meteors with irregular, or zigzag, paths have been comparatively rare in my experience. On the evening of June 29, 1924, at 8:15 C.S.T., I observed a very fine specimen of this type. It first appeared in the southwest quadrant about 15 degrees below, or southwest, of Spica and swept over an almost due east course into the northern boundary of the constellation Lupus, traversing a distance of some 35 degrees. The meteor was of the 1.0 magnitude and of a dull red color. The velocity was extremely low which might be partially accounted for by the fact that the meteor was traveling in nearly the same direction as the earth. The zigzag motion was very noticeable and was remarked about by two or three observers who had probably never seen or heard of such a thing before.

The following suggestion is made, which might account for the action of these meteors. A small, flat stone with an uneven surface when thrown from a boy's catapult or "niggershooter" as they are called here in the south, will follow a zigzag path and in some cases a spiral, due to the unbalanced action of the air against the stone. A meteor which is very flat in shape would probably act in the same manner. I should be glad to hear from anyone who has observed any of the above class of meteors. Sterling Bunch.

Box 181, Stockyards Station,
No. Ft. Worth, Texas.

A Remarkable Meteoric Phenomenon.—On the evening of May 22, 1924, at 7:51 p. m., while walking rapidly past trees in Court House yard here I caught a glimpse of a very bright meteor train, at least as bright as Venus and about same diameter at lower end, and four times that diameter at upper end. I at once stepped back three or four steps into the opening where I could see the whole train. The upper two-thirds had assumed a wavy appearance; the bottom third was still straight and bright. The upper part was in two large waves about twice as wide as deep and the band of light about half as wide as wave was deep, with smaller waves towards the tail which tapered off into a whip-like end. The bottom part narrowed to about the diameter of Saturn where it had an indistinct end and about another diameter below was a pale and hazy but distinct star-like spot about the size of Saturn. This kept dropping down very small bright spots showing a faint trail for about half the diameter of the moon. (This may have been an optical illusion, but it seemed very real to me.) Time was a little past 7:51 p. m., 75th meridian time. Sky perfectly clear and only a few bright stars showing.

At 7:52 the two waves stretched out and broadened and the opening in the waves closed up. The upper and lower ends of train became faint; also the star-like head, but it still dropped a few faint spots showing trails.

At 7:53 the train formed two pale but distinct lens-shaped clouds, rather sharp on the ends toward each other and bending off in faint trains towards the upper and lower ends of the original train. In a vertical line the two lenses overlapped about one-third their length.

At 7:54 they were two oval, pale white but distinct clouds, each with a hazy cloud-like formation extending out past the end of the others.

At 7:56 they were two nearly round pale, white, faint clouds. They had been getting larger and rounder all the time as well as paler and fainter. I had a good range line on them and the N. E. one moved but little towards the S. W. at its eastern end but the whole thing seemed to stretch out towards the S. W. until the two outside ends were about three diameters of the moon apart. At this time smoke from an electric station shut out further view. Smoke was drifting near the surface and rapidly toward the S. W.

The trails left by the bright spots dropping down were not persistent like the train but like that made by a rapidly moving point of light. The faint star-like head did not seem to move at all. The clouds that formed seemed to keep the

DATA.

May 22, 1924, 7:51 p. m., 75th meridian time.

Latitude 38° 46′; longitude 76° 04′.

Elevation of observer's eye 33 feet above sea level.

Azimuth about 45° west of north (estimate from a good meridian).

Elevation of lower end about 22½° above horizontal.

Inclination when first seen about 30° from vertical, towards south-west.

Total length of train when first fully seen about half the distance between Castor and Pollux.

Horizontal length between outside ends of two clouds when last seen about three diameters of the moon.

R. H. BLAIN.

Easton, Maryland, May 25, 1922.

GENERAL NOTES

Professor A. O. Leuschner, director of the Students' Obsrvatory, University of California, has been elected a member of the American Philosophical Society.

Dr. C. E. St. John, astronomer at the Mount Wilson Observatory, and Dr. Harlow Shapley, director of the Harvard College Observatory, have been elected members of the National Academy of Sciences.

Mr. Harold Knox-Shaw, of Trinity College, Cambridge, director of the Observatory at Helwan, Egypt, has been appointed to be Radcliffe Observer, as successor to the late Dr. A. A. Rambaut.

Robert Meldrum Stewart has been appointed Director of the Dominion Observatory at Ottawa. Mr. Stewart is a graduate of the University of

Toronto, having obtained the degree of B. A. in 1902 and of M. A. in 1903. Soon after this he was appointed to the newly organized observatory at Ottawa. One of his achievements there is a time service for the numerous government buildings of exceptional efficiency. He also established a meridian circle, with which much accurate work has been done. From it the accurate determinations of longitude and latitude throughout the country are controlled. In 1918 Mr. Stewart was made Assistant Director. In 1922 Dr. Klotz visited Europe, but the effort so impaired him health that he was able to be at the observatory only occasionally thereafter, and he died in December last. During his absence Mr. Stewart was Acting Director.—*The Journal of the Royal Astronomical Society of Canada*, June-July, 1924.

Reynold Kenneth Young has been appointed Associate Professor of Astronomy in the University of Toronto. He is a graduate of the University, being a B. A. of 1909. Immediately after receiving his degree he was made Fellow in the Lick Observatory, and after three years of training there and at Berkeley he received the Ph. D. degree from the University of California. He then spent a year at the University of Kansas as Instructor in Physics and Astronomy, and then was appointed to the observatory at Ottawa. In 1918 he went with Dr. Plaskett to be an astronomer in the Dominion Astrophysical Observatory at Victoria, B. C., and he has assisted to make the reputation of that institution throughout the world. His latest completed research was in collaboration with Mr. W. E. Harper and consisted in the determination of the parallax of over 1000 stars, an account of which appeared in this Journal in the first issue for 1924.—*The Journal of the Royal Astronomical Society of Canada*, June-July, 1924.

Miss Mabel Weil, who was associated for several years with the late Professor E. C. Trowbridge in his important researches on meteors and meteor trains, died suddenly at her home in Brooklyn early in June. Several papers by Miss Weil have recently appeared in POPULAR ASTRONOMY.

Franklin-Adams Chart.—A subscriber recently asked whether we had any means of securing a copy of the Franklin-Adams chart. He stated that it was no longer possible to obtain it from the Royal Astronomical Society which published it. It is possible that some one of our readers may know of a copy which is not in use and which could be purchased. Any information of this kind would be greatly appreciated by the editors of POPULAR ASTRONOMY.

Balanowsky's Nova in Messier 87.—As reported in *Astronomische Nachrichten*, No. 215, 1922, a nova was observed by Balanowsky in the nebula Messier 87 (N.G.C. 4486) on photographs made February 24, 1919, magnitude 11.5, and March 22, 1919, magnitude 12.2. Messier 87 is a spherical nebula with no trace of spiral structure.

Miss Woods finds the nova on a Harvard photograph, MC 15773, taken March 3, 1919. The magnitude is 12.4. The nova appears on no other Harvard plate, but was photographed with the 100-inch reflector at Mount Wilson by Hubble in 1920 at magnitude 19.5 or fainter (P. A. S. P., **35**, 261, 1923). A Bruce photograph made at Arequipa, May 10, 1904, shows neighboring stars of the eighteenth magnitude.

Harvard College Observatory Bulletin 803.

Meteorite found at Chippewa Falls, Wisconsin.—On the morning of December 6, 1923, the people of Alma Center, Wisconsin, and vicinity noticed a sudden illumination in the sky and heard a detonation like an explosion. At the time it was attributed to the falling of a meteorite. Recently a fragment was found in Chippewa Falls which is thought to have been the cause of the phenomena observed on December 6. It is now at the office of the *Chippewa Herald*, and is described as "about a foot square though irregular in shape, and about six inches thick. It weighs 52½ pounds and is a mass of stone and metal."

Note on a Star Cloud in Sagittarius.—Concurrently with the study of the Magellanic Clouds, a comparative investigation of the extent and structure of certain galactic star clouds is being made at the Harvard Observatory. There appear to be some Milky Way clouds, in Sagittarius for instance, where gaseous nebulae, O-type stars, and star clusters are also concentrated; but as yet the clouds along the Milky Way have not yielded faint Cepheid variables comparable in number with those found in the non-galactic Magellanic Clouds and in many globular clusters.

Seventy-eight faint variable stars are now known in a region of about twenty square degrees in Sagittarius, immediately south of the densest star cloud in Scutum. The field is centered at $18^h\,55^m$, $-13°.4$, near Nova Sagittarii 1898.2. Twenty-nine of these variables were discovered by Miss Leavitt and announced in Harvard Circular 141, 1908. Fifteen others, suspected by Miss Leavitt (H. C. 141, Table II), were proved to be variable on plates secured during the last two or three years (H. B. 783, 1923). A list of thirty-four additional variables, found by the writer more than a year ago, is given below. [The list is omitted here since the stars are all too faint to be studied by other than professional astronomers, Ed.. P. A.] The magnitudes are provisional. The systematic study of the light curves and periods will await the establishment of special magnitude sequences around this and the neighboring regions which are now under examination for faint variables.

Harvard College Observatory Bulletin 804.

The International Mathematical Congress. — The International Mathematical Congress will be held at Toronto, Canada, August 11 to 16, 1924, under the auspices of the Royal Canadian Institute and the University of Toronto.

This is the first meeting of the Congress to be held on the American Continent.

Special prominence will be given at this meeting to the engineering and other practical applications of mathematics, and contributions have been invited from Mathematical Physicists and Engineers engaged in mathematical investigations of engineering problems.

The proceedings of the Congress will be printed and it is hoped that they may form a complete contemporary account of the pure and applied mathematical sciences.

Seventy scientific institutions on the American continent and ninety in Europe and elsewhere have arranged to send one or more delegates to the Congress.

The Congress will meet in the following sections:

Section I: Algebra, Theory of Numbers, Analysis.
Section II: Geometry.
Section III: (a) Mechanics, Mathematical Physics.
(b) Astronomy, Geophysics.

Section IV: (a) Electrical, Mechanical, Civil and Mining Engineering.
(b) Aeronautics, Naval Architecture, Ballistics, Radiotelegraphy.
Section V: Statistics, Actuarial Science, Economics.
Section VI: History, Philosophy, Didactics.

This arrangement of sections is designed to afford, in the sphere of applied mathematics, full opportunity for consideration, not only of those questions in which interest is purely scientific, but also of practical problems of engineering, the solution of which contributes directly to the cause of progress.

Additional information may be obtained from Professor J. K. Synge, Royal Canadian Institute, Toronto, Canada.

At the conclusion of the Congress many of the European delegates will join the members of the British Association for the Advancement of Science in an excursion through Canada to Vancouver on the Pacific coast.

The British Association will hold its 92nd Annual Meeting in Toronto from August 6 to August 13.

American Astronomical Society.—The summer meeting of the American Astronomical Society will be held at Dartmouth College, Hanover, New Hampshire, from August 3 to 6. The date has been fixed immediately preceding the meeting of the British Association for the Advancement of Science at Toronto, Canada, which opens on August 6. It is expected that a number of British astronomers and other men of science will be present at the meeting of the Society.

The following information is given in a circular issued by Secretary Stebbins June 10, 1924:

"The most used railroad station for Dartmouth is White River Junction, Vermont, from whence there is a bus service to the college, distance about five miles. The following routes are given:

Montreal to White River Junction, from Bonaventure Station via Canadian National Railways, 186 miles.

Boston to White River Junction, from North Station via Boston & Maine R. R., 143 miles.

New York to White River Junction, from Grand Central Terminal via New York, New Haven & Hartford R. R., 258 miles.

Members who expect to attend both the Dartmouth and Toronto meetings will probably want to take advantage of summer tourist fares which will allow stopovers. Reduced fare on the certificate plan to the Toronto meeting is only slightly less than the summer fare, and does not allow stopovers. On some trains there is railway connection from White River Junction to Norwich, Vermont, across the river from Hanover, about one-half mile from the college, but it would ordinarily be better to take a bus from White River Junction. Bus rates, 50c per person, trunks $1.00. Special autos may be had for $2.50 for a party of five, additional persons 50c each.

The attractive location of Dartmouth is well known, and the college dormitories will be thrown open for the entertainment of visitors. Meals will be served at the Hanover Inn, owned and managed by the college. Rates for rooms at the dormitories will be $1.00 per person for lodging two persons in a double room, other accommodations in proportion. Intending visitors should send requests for reservations to Professor John M. Poor, Hanover, New Hampshire. Table

d'hote meals at the Inn dinning room will be: Breakfast, $1.00; luncheon, $1.50; dinner, $1.50. There will also be à la carte service at the Inn coffee room in the same building.

Mail should be addressed care of the American Astronomical Society, Dartmouth College, Hanover, New Hampshire.

As an innovation at this meeting, it is proposed that the members gather informally on Sunday, all trains arriving by mid-afternoon. If the weather is favorable, it is proposed to have the Sunday-evening meal at the Moose Mountain Cabin of the Outing Club, about eight miles from the college. Autos may drive within less than a mile from the cabin, but from this point one must walk over a trail and wood road. The climb is not difficult from the cabin to the mountain top, a rise of 1000 feet in a distance of 2 miles.

There will be no occasion in connection with the meeting requiring formal dress, but it is probable that many will want to bring heavy shoes and clothing for mountain walks. Small parties can arrange for tramps through the surrounding country, and the cabins of the Outing Club will be placed at the service of the guests of the college. If desired, an outing can be arranged on Wednesday afternoon with a stay overnight at the Tip-Top House on Moosilauke, altitude 4800 feet. This is kept open by Dartmouth students and can be used by those desiring to make the trip of about 45 miles by auto to the base of the mountain, and then a climb by trail of five miles, or on a wood road for seven miles.

Two New Variable Stars in N.G.C. 1851.—From an examination of five Bruce plates, made in 1923, of the region of N. G. C. 1851, two variables were found in the cluster, none in the adjacent field. The coördinates of the variables, H. V. 3732 and 3733, referred to the center of the cluster, are $x = +261''$, $y = -9''$, and $x = -45''$, $y = +30''$, respectively. By taking from the New General Catalogue, $5^h\ 9^m\ 30^s$, $-40°\ 12'3$, as the 1860 position for the center of the cluster, the positions of the variables for 1900 are $5^h\ 11^m\ 12^s$, $-40°\ 9'6$, and $5^h\ 10^m\ 45^s$, $-40°\ 8'9$. The magnitude of each variable at maximum is about 14, and each has a range of about a magnitude and a half. There is not a sufficient number of plates for the determination of the periods, which are probably short.

(S. I. B.)

Harvard College Observatory Bulletin 802.
Cambridge, Massachusetts, April 7, 1924.

The Constellations of the Zodiac.—The following rhyme, attributed to Dr. Watts, the celebrated hymn writer and divine, may be useful to those who wish to memorize the order of the Signs and Constellations of the Zodiac:

"The Ram, the Bull, the Heavenly Twins
And next the Crab, the Lion shines,
The Virgin and the Scales;
The Scorpion, Archer, and Sea-Goat,
The Man that holds the Water-Pot,
And Fish, with glittering Scales."

The Latin names of these constellations are: *Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpius, Sagittarius, Capricornus, Aquarius,* and *Pisces.*